# Engineering News-Record

*A Consolidation of Engineering News, Engineering Record The Sanitary Engineer, and The Contractor*

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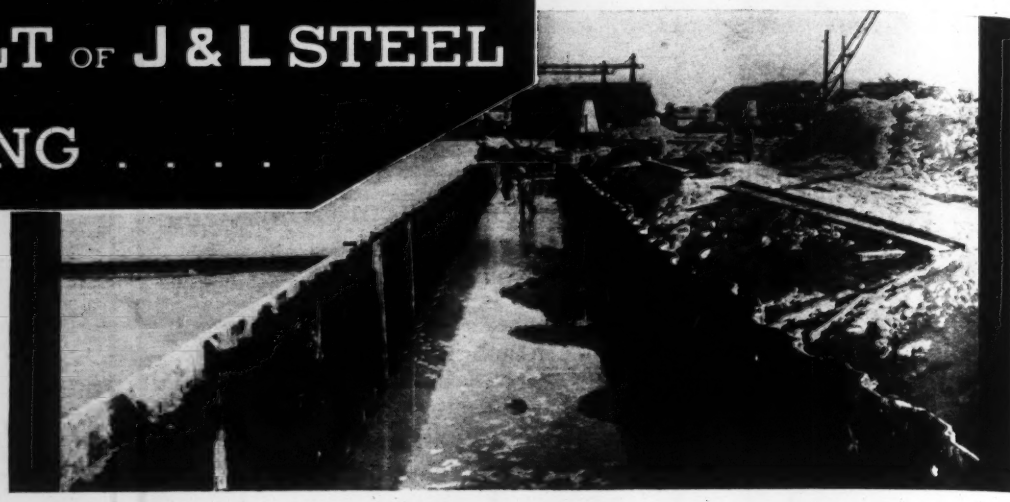
Published every Thursday. Price 25c. per copy. Subscription, domestic, Central and South America, $5 per year. Canada, including duty, $7.50. Foreign $9 or 45 shillings. Entered as second-class matter at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A. Cable address: "MCGRAWHILL, New York." Member A.B.P. Member A.B.C.

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

Editorial and Publishing Offices: 330 West 42d St., New York; 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, W. C. 2, England. Branch Offices: Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Greenville, S. C.; Los Angeles. James H. McGraw, Chairman of the Board; Malcolm Muir, President; James H. McGraw, Jr., Vice-President and Treasurer; Mason Britton, Vice-President; Edgar Kobak, Vice-President; H. C. Parmelee, Vice-President and Editorial Director; Harold W. McGraw, Vice-President; C. H. Thompson, Secretary.

# BREAKWATER FOR SUBMARINE BASE BUILT OF J & L STEEL PILING . . . .

View shows the J & L Steel Piling walls that form a portion of the bulkhead of the breakwater for the submarine base, Key West, Florida.



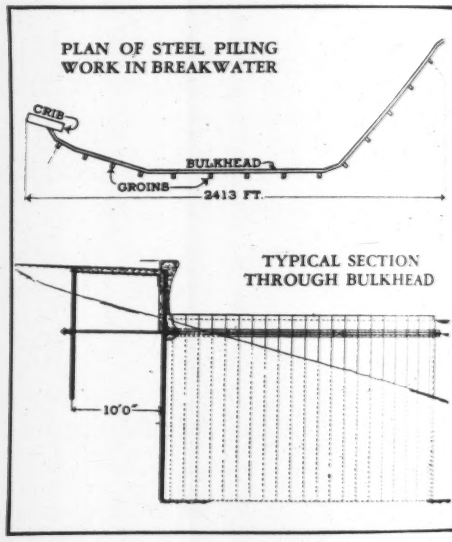
## U. S. GOVERNMENT PROJECT AT KEY WEST, FLA.

The use of nearly 1700 tons of J & L Steel Piling section EC-22 in the breakwater construction of the submarine base at the United States Naval Station, Key West, Florida, again signifies the acceptance of J & L Steel Piling, by the Civil Engineers Corps, U. S. Navy, for use in government work.

The excellent performance of the J & L Steel Piling, both in assembling and driving, enabled the contractor to set and drive as many as sixty piles a day during the majority of the working time. This resulted in a driving cost per square foot of piling wall quite satisfactory to the contractor.

The project was designed and is being constructed under the direction of Commander Gaylord Church of Washington, D. C., and the U. S. Navy Engineers at Key West. The construction work is being carried out by the Van Gordon Construction Company of Jacksonville, Florida.

The Jones & Laughlin Steel Corporation maintains a special engineering staff and invites inquiries on all types of steel piling work, which will be analyzed promptly and reported upon in detail.

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# Engineering News-Record

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# Record Earth-Pressure Testing Machine

**Precision device installed at Massachusetts Institute of Technology for testing pressure of earth against retaining walls is the largest in the world—First used in connection with retaining-wall design for Fifteen Mile Falls dam**


By Dr. Karl Terzaghi

*Professor, Technische Hochschule Vienna, Austria*

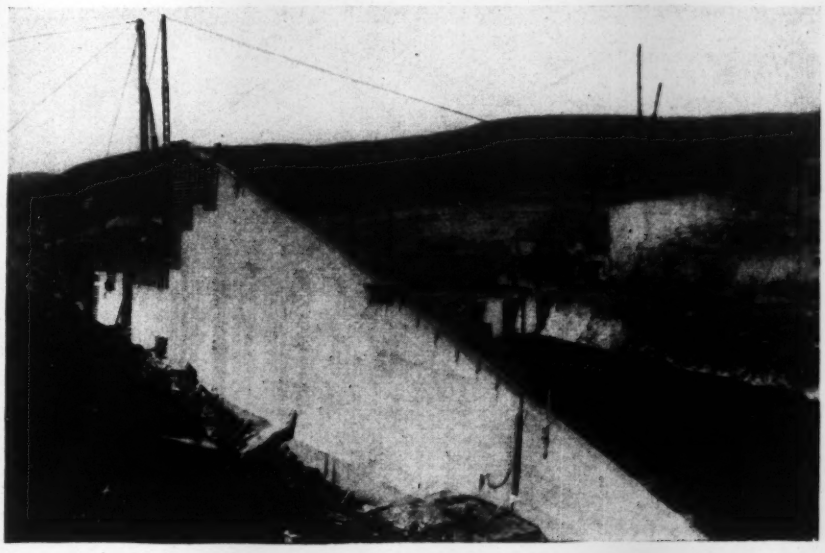

IN CONSTRUCTING the lower Fifteen Mile Falls dam for the New England Power Construction Co., several controversial questions of design arose in planning the 700-ft. long retaining wall separating the concrete part of the dam from the earth embankment part. The character and dimensions of this wall as built are shown by the construction view (Fig. 1) and by the drawings of Fig. 2. To settle the questions of design conclusively, a series of large-scale earth-pressure experiments was necessary.

Considering the vital nature of the questions and the magnitude of the expenditure involved in the construction of the wall, it seemed warranted to construct an apparatus of ample size and equipped with all the refinements required to eliminate the errors connected with previous experimental investigations of this kind. It also seemed necessary to make provisions for securing quantitative information concerning the effect of the rigidity of a wall on the intensity of the lateral earth pressure, and concerning the effect of partial and total saturation of the backfill.

To obtain the information, the apparatus for making the tests had to comply with the following requirements:

1. The test wall should be of ample height; a height of 7 ft. was selected.
2. The effect of the friction along the side walls of the test material bin on the intensity of the earth pressure should be negligible.
3. The wall should be rigid enough to stand combined earth and water pressure without the deflection of the wall between the points of support exceeding an amount of about 1/100 mm., or 1/200,000 the height of the backfill.
4. It should be possible to measure the vertical and the horizontal component of the earth pressure without the wall moving through a distance of more than 1/100 mm.
5. It should be possible to raise the groundwater level behind the wall to the surface of the fill without the water leaking away through the joint between the bin and the wall. It should also be possible to raise or lower the level of the groundwater during the test and to ob-

Fig. 1—Power development of New England Power Association at Fifteen Mile Falls showing 170-ft. high retaining wall which led to construction of world's largest earth pressure testing machine.



serve the position of the water level at numerous points.

6. Finally provisions had to be made to move the wall parallel to itself, to tilt it, to raise or to lower it, without severing the water tight connection at the joints.

The following is a description of the device that satisfies these requirements.

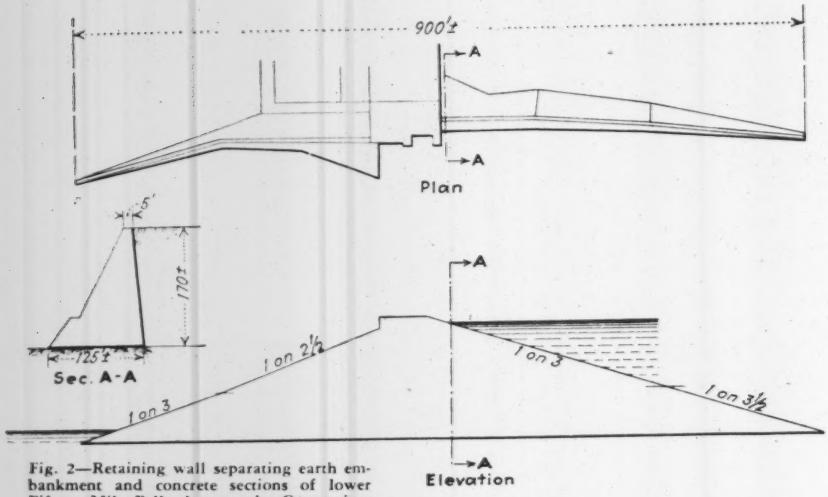



Fig. 2—Retaining wall separating earth embankment and concrete sections of lower Fifteen Mile Falls dam on the Connecticut River between northern Vermont and New Hampshire.

It represents at present both the largest and the most sensitive equipment which exists, in any country, for earth-pressure investigations.

## Effect of side friction

The selection of the width of the bin used to hold the test material was governed by the condition that the effect of the friction along the side walls on the intensity of the earth pressure should be negligible. Fourteen years ago, the author found by means of small-scale tests on several model retaining walls of equal height and different lengths that the intensity of the earth pressure is practically independent of the length of the wall, provided that the length of the wall exceeds twice the depth of the fill. The results of these tests agree with the results of computations based on the formulas derived by previous investigators.

Assuming for the coefficient of friction between the fill and the wall a value of 0.55, which is excessive, the error due to side friction by means of the empirical formula of Winkler is 2.3 per cent. The theoretical formula of Mueller-Breslau leads to values ranging between 2 and 3 per cent, depending on the value of the coefficient of internal friction of the backfill. However, these formulas are valid only on condition that the "sliding wedge" is acted upon by the full amount of the side friction. For narrow bins, due to horizontal arching effect, this assumption is undoubtedly correct, while in wide bins the arching effect is at the very best incomplete. Hence, for wide bins the error due to side friction should remain considerably below the theoretical value.

For these reasons, it was decided to make the width $b$ of the bin equal to twice the height $h$ of the backfill, i.e. equal to 14 ft. In order further to reduce the effect of side friction, the walls of the bin were provided with a smooth, waterproofed cement lining, $\frac{3}{4}$ in. thick, whose surface was covered with two coats of water-glass.

During the tests it was observed that the crack which appeared on the horizontal surface of the back fill, in an advanced state of most tests (inner boundary of the sliding wedge), was fairly straight over a length of about 11 ft. At the ends of this straight section it bent toward the ends of the retaining wall. One of the tests was repeated with the side walls of the bin lined with a $\frac{1}{8}$-in. layer of cup grease, having a coefficient of friction of 0.05. The lubrication had no effect on the intensity of the earth pressure or on the shape of the boundary of the sliding wedge, and in neither case did a slip occur along the sides of the bin. Since the boundaries of the wedge represent zones of least resistance, the retarding forces acting on the wedge in the vicinity of the side-walls must always have been smaller than the friction acting along the lubricated side walls. This fact substantiated the assumption that the effect of the side friction is a negligible item for a bin with $b=2h$.

## Bin structure

Based on the preceding considerations, it was decided to make the bin 14 ft. wide and 14 ft. long and to provide it with a model retaining-wall 7 ft. high. The horizontal component of the earth pressure is measured in four points, the vertical component in two points. Fig. 3 shows the arrangement of the principal parts of the testing outfit. The model retaining wall consists of a steel frame $F$, lined with a reinforced-concrete slab 5- in thick. It

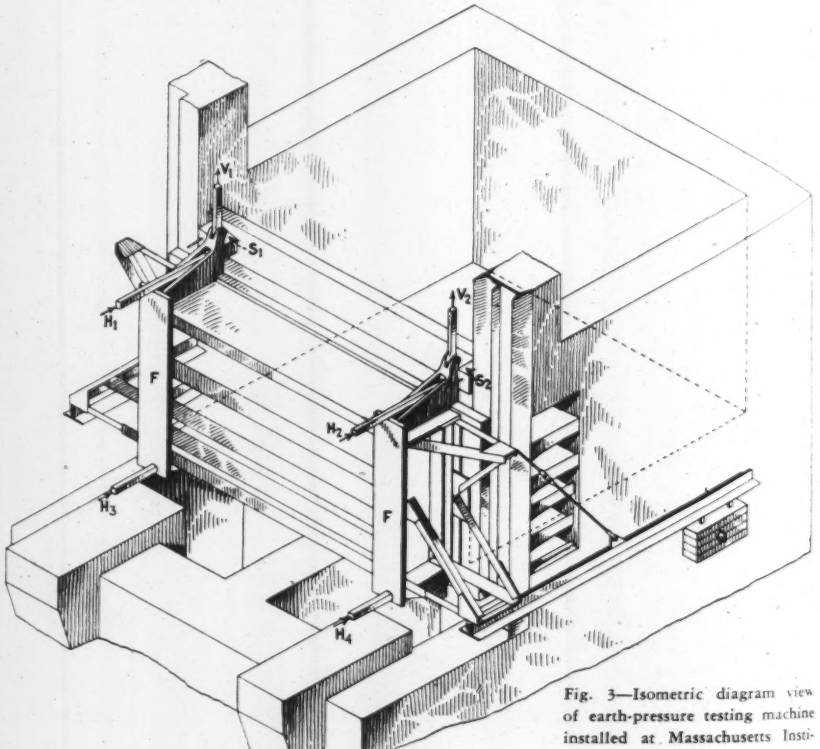



Fig. 3—Isometric diagram view of earth-pressure testing machine installed at Massachusetts Institute of Technology laboratories.

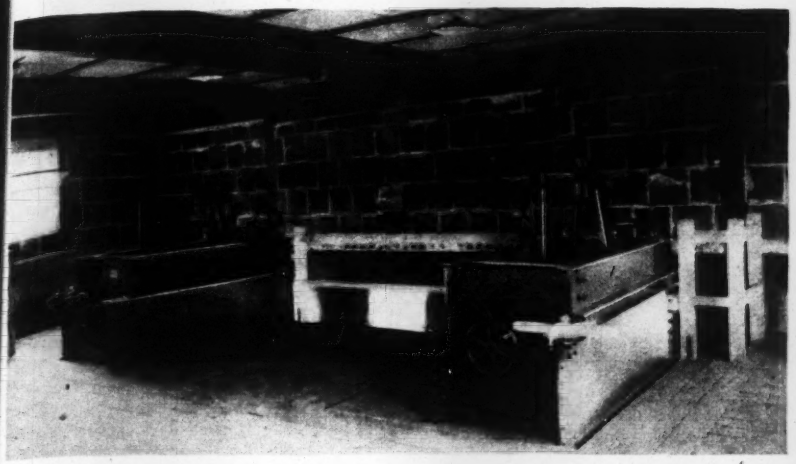


Fig. 4—Scales for measuring vertical component of earth pressure on a wall in Massachusetts Institute of Technology testing machine.

weighs 13 tons and is suspended on two vertical steel rods, $V$ and $V_2$ 2½ x 2½ in., whose axes coincide with the bin-face of the reinforced-concrete slab. The rods $V_1$ and $V_2$ transmit both the weight of the wall and the vertical component of the earth pressure to two weighing devices, Fig. 4, located above the bin.

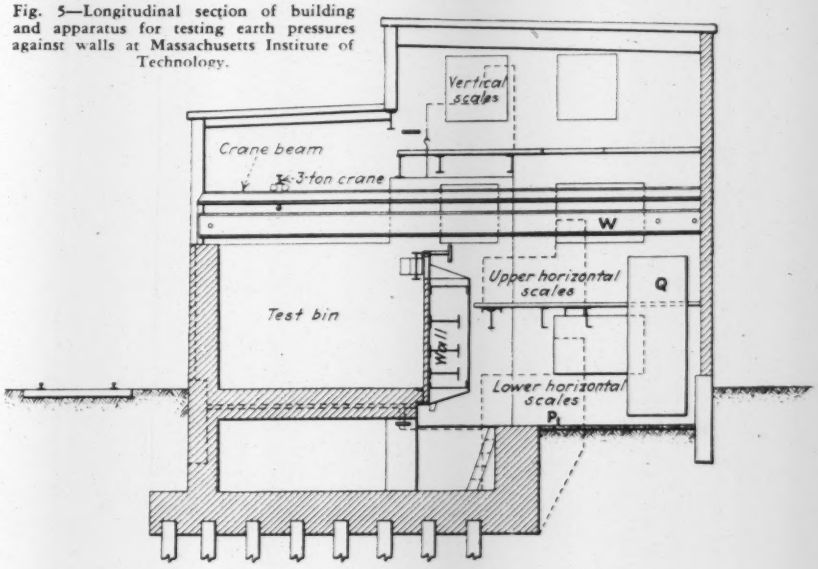
In order to maintain the bin face of the wall strictly in a vertical position, the wall was provided with counter-weights $Q$, fastened to a cantilever construction. The contact between the wall and the horizontal weighing devices is established by means of the horizontal thrust-rods $H_1$ to $H_4$, which have a cross-shaped section, 4 x 4 in. Both ends of these rods are provided with knife edges with spirit levels to check the horizontal position. On the bin side, the knife edges of the thrust-bars rest against bearings in steel castings which, in turn, are bolted to the vertical structural members of the wall.

In order to prevent a backward motion of one part of the wall, while another part of the wall is moved out, four studs, $S_1$ *to* $S_4$, were provided. The center line of each stud coincides with the center line of one of the four thrust-rods, $H_1$ to $H_4$. The studs also are steel rods, of which the upper ones, $S_1$ and $S_2$, have a diameter of 1½ in. and the lower ones a diameter of 2 in. They are provided with flat heads bevelled ¼ in., which bear against a polished steel plate fastened to the same castings which form the bearings for the thrust-rods. The distance between the knife edges of the thrust-rods and the heads of the studs is 6 in. The studs are operated by means of gears. Since the steel castings are caught between the knife edges of the thrust-rods and the heads of the studs, either the upper or the lower part of the wall can be rigidly maintained in any position while the other part is moved.

Fig. 5 shows a cross-section of the testing outfit as actually constructed. Since the testing materials, each sample of which consisted of 1,400 cu.ft., had to be shipped by railroad, the bin was built close to a side-track of the Boston & Albany R.R., with the bottom of the bin at about track level.

The side walls and the bottom of the bin are 1:2:4 concrete, with 10 per cent of hydrated lime, heavily reinforced. The retaining wall consists of a very heavy reactangular steel frame, stiffened by means of three horizontal 24-in. I-beams. The 5-in. reinforced-concrete lining rests directly against the flanges of the beams. The lower weighing devices, Fig. 7, are seated on concrete foundations $P_1$. The upper weighing devices, Fig. 6, and the weighing devices for the vertical component, Fig. 4, are mounted on the first and the second floor of the building. The space beneath the bin had to be made accessible in order to get access to the operating wheels for the lower studs of $S_1$, Fig. 3, and to the pipe lines which lead to a set of pressure cells.

Fig. 5—Longitudinal section of building and apparatus for testing earth pressures against walls at Massachusetts Institute of Technology.




## Weighing devices

The weighing devices were designed for the following maximum loads:

| | Per Scale |
|---|---|
| Lower horizontal thrust (two scales) | 25,000 lb. |
| Upper horizontal thrust (two scales) | 12,000 lb. |
| Maximum vertical forces, including the weight of the wall (two scales) | 16,000 lb. |

The four horizontal scales are equipped with horizontal adjustment screws, operated by means of hand-wheels and located at the rear end of the scales. Each revolution on the hand-wheel advances the scales through a distance of 0.00823 in. The two scales for the vertical component are equipped with both horizontal and vertical adjustment screws. By means of the vertical adjustment screws the point of suspension of the vertical bars can be lowered through a distance of 0.1 in., or raised through a distance of 0.35 in.

All the horizontal scales are of the same type, with three-lever multiplications. The horizontal push, exerted by the thrust-bars, is transformed into a vertical force by a knee lever. The horizontal movement through a distance of 1 in. is afforded by a lead screw, moving the whole weighing mechanism on V-ways. The lead screw is operated by worm and gear. The lower scales, with a capacity of 25,000 lb., are graduated to 5 lb., and the upper ones (capacity 12,000 lb.) are graduated to 2 lb. Each one of the vertical scales has a capacity of 3,000 lb. in excess of the load due to the weight of the model wall itself (13,000 lb. per scale)

and is graduated to 2 lb. They have also a three-lever multiplication. The scales are mounted on box frames which can tip around a horizontal shaft. The movement is produced by a lead screw, operated by worm and gear. The box frame, together with the horizontal shaft, is also housed in a box frame seated on rollers. By means of the lead screw, the outer box frame can be moved through a horizontal distance of 1 in. so as to keep the points of suspension always exactly above the inner face of the retaining wall. The weight of the wall is counterbalanced within the scale, so that the scale readings give the forces in excess of the permanent weight. When the bin is filled with earth, the error of the reading on the top scales does not exceed 10 lb.

The maximum movement of the scale beams corresponds to a movement of the points of pressure application (load application for the top scales) of approximately 1/10,000 in.

Fig. 6—Upper scales for measuring horizontal component of earth pressure showing operating table for Goldbeck pressure cells.

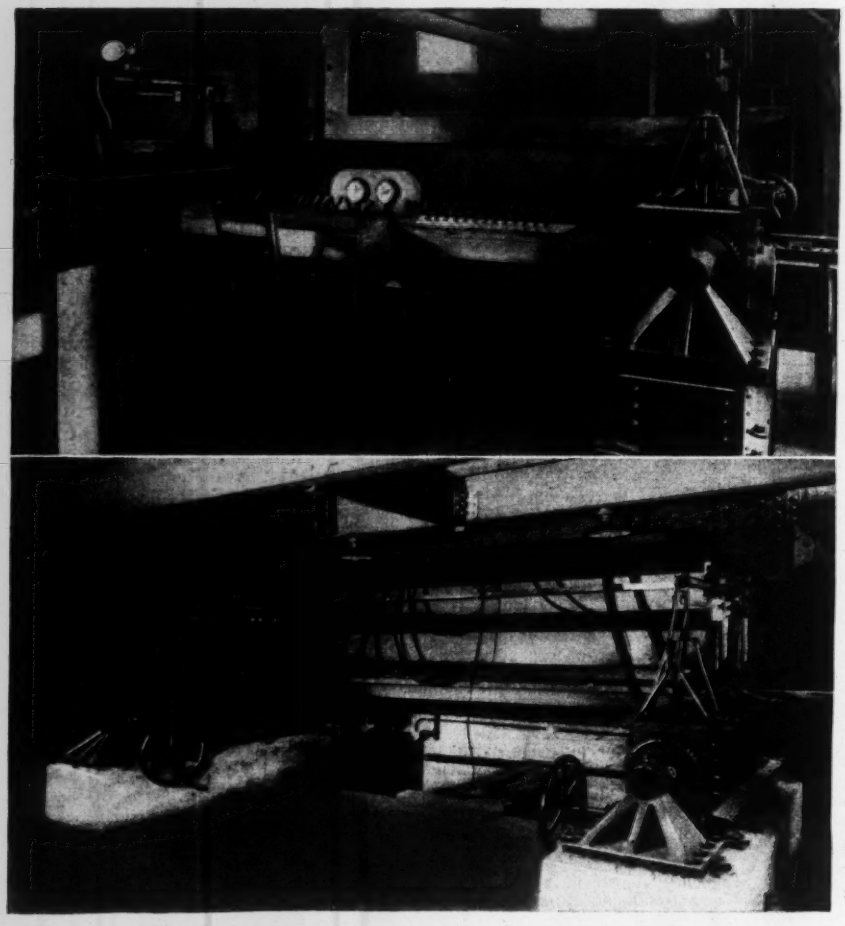


Fig. 7—Lower scales for measuring horizontal component of wall pressure, showing piping to Goldbeck pressure cells.

The watertight joint between the wall and the bin is shown in Fig. 8. It consists of a strip of two-ply rubber fabric 8 in. wide and $\frac{1}{8}$ in. thick. The joints between the rubber and the metal strips were sealed by means of rubber cement. It required some experimenting until the joints were tight. Similar difficulties were encountered when attempting to seal the joints between the concrete and the casings for the stud gears and the joints of the window. In order to prevent the sand or the earth from penetrating the fold, formed by the rubber strip, this fold was loosely but completely filled with cotton. This cotton fill served its purpose to perfection.

## Mechanical accessories

Among the accessories of the testing device, the following should be mentioned:

Twenty Goldbeck pressure cells, ten built into the wall and the rest into the floor of the bin.

A window, 3½ ft. wide and 7 ft. high, in the right-hand wall of the bin. The window is 1-in. plate glass, resting against the flanges of heavy I-beams. There is a joint between the plates at the center line of each I-beam. The plates are held against the flanges by means of white lead putty.

Standpipes (18-in. in the left-hand wall and 8-in. in the right-hand wall) are provided for observing the position of the saturation line. The standpipes are $\frac{7}{8}$-in. glass tubes, communicating with the interior of the bin through ¼-in. brass pipes. The lower ends of the glass tubes are provided with stop cocks, and the inner ends of the pipe across the concrete wall are provided with a wire mesh to prevent soil particles from getting into the pipes.

A feed and drain system for saturating the fill consists of a 2-in. horizontal feed pipe across the bin near the upper edge of the rear wall, four 1-in. vertical feed pipes (one in each corner and the two others equally spaced) descending from the horizontal pipe to within 1 in. of the bottom of the bin, and two 1-in. drain pipes near each front corner of the bin, with their inlets flush with the bottom of the bin.

To perform surcharge tests, a load beam (Fig. 5) was installed bearing against a knife-edge fulcrum at the rear end of the bin. To produce at this end of the beam an upward reaction, whether or not a load test is being performed, the rear end of the beam is connected with a 100-lb. counterweight, mounted at the outer end of a 1:10 lever. The other end of the beam carries a load tank $Q$ with a capacity of 5 tons of water. Both the dead weight of the beam and of the tank are counterbalanced, as shown in Fig. 3, with about 3,500 lb. of main counterweight. The hanger of tank $Q$ rests on a knife-edge mounted on the upper flange of the load beam. The bottom of the tank is provided with an outlet opening which drains into a sink. Small quantities of water (low surcharges) are measured directly before they are poured into the tank. Larger quantities can be computed from the readings made on a vertical standpipe, mounted on the outside of the tank.

To perform a surcharge test, a block is placed on top of the fill in the bin,

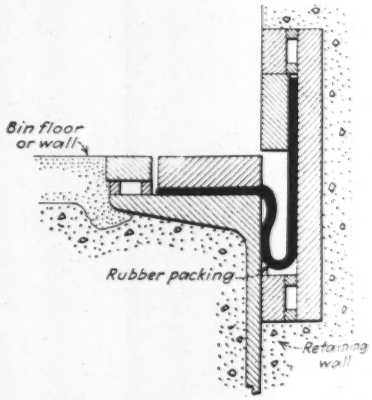



Fig. 8—Watertight joint between ends of retaining wall and sides of bin containing earthfill.

and a hydraulic jack is inserted between the block and the beam $W$. When a "constant load" test is made, the load is applied by feeding the required quantity of water into the tank $Q$, and the jack merely serves to maintain the beam $W$ in a horizontal position, while the settlements increase. For ordinary loading tests the load in the tank is kept constant and the application of the pressure is made by means of the hydraulic jack, the beam $W$ merely serving as a bearing for the jack. The jack, the blocks and other accessories can be transported within the building by means of a 3-ton hand-operated traveling crane.

The storage bin for the test material consists of three compartments, the middle one holding 81.5 cu.yd. and the two outer ones 61 cu.yd. In each bin, near the floor, are drain pipes for discharging excess water. The floor of the middle compartment has a steam coil connected with a steam main.

### Calibration

The calibration of the testing device required three independent operations, viz.:

1. Calibration of the scales.
2. Determination of the corrections to be made on the readings for stresses in the rubber joint, water pressure against the rubber joint and similar disturbing factors.
3. Determination of the deformations of the test bin and of the retaining wall under water pressure.

The calibration of the scales was performed by standard methods and presented no difficulties.

For determining the corrections on the readings, a complete test was made, including scale readings for different positions of the wall, with the test bin filled with water and with the test bin empty.

### Errors of observation

The errors of observation were essentially due (1) to the imperfect elasticity of the rubber sealing strip, (2) to the deflection of the wall under the influence of the earth pressure, and (3) to the warping of the wall, caused by temperature changes.

The importance of the error due to the first cause could be learned from the difference between the results of the calibration, performed before and after each test. It did not exceed 50 lb. per scale, a very small item if compared to the intensity of the forces which were to be measured. Since the errors connected with the measurement of the upper and lower component partially compensated each other, the total error in measuring the horizontal component of the earth pressure did not exceed an amount of 50 lb.

The deformation of the wall, due to a change of the intensity of the earth pressure, was small if compared with the deflections of the wall produced by temperature changes. While the bin was being filled the inner flanges of the steel frame of the wall assumed the temperature of the earth, while the outer flanges retained the temperature of the atmosphere. However, in no case during the tests did the deflection of the wall exceed 0.0017 in. Normally, it was very much smaller. Hence, as a whole, the errors connected with the determination of the intensity and the direction of the earth pressure, and with the investigation of the influence of movements of the wall on the intensity of the pressure, could be considered negligible.

In contrast to the satisfactory service rendered by the scales, the Goldbeck pressure cells were found to be utterly unreliable. In spite of the fact that each one of the cells was calibrated under water pressure after it was mounted in place, the cell readings for earth pressure were so erratic that no reliable results were secured.

An agreement between the Massachusetts Institute of Technology and the New England Power Construction Co. provided that the institute was to furnish the foundation for the testing device, to prepare the working drawings for the testing equipment and to supervise the construction, while the New England Power Construction Co. was to pay for the superstructure of the building and all of the equipment. The general layout of the testing devices was prepared by the author. The mechanical equipment of the earth-pressure apparatus, including the scales and the operating gears for the studs, was designed by John F. Dreyer and Henry B. Gibbons, graduate students of the Massachusetts Institute of Technology, under the supervision of Prof. E. F. Miller, head of the department of mechanical engineering. The installation cost was about $50,000 for buildings and equipment.

# Cost of Road Patching Cut by Hot-Oil Truck

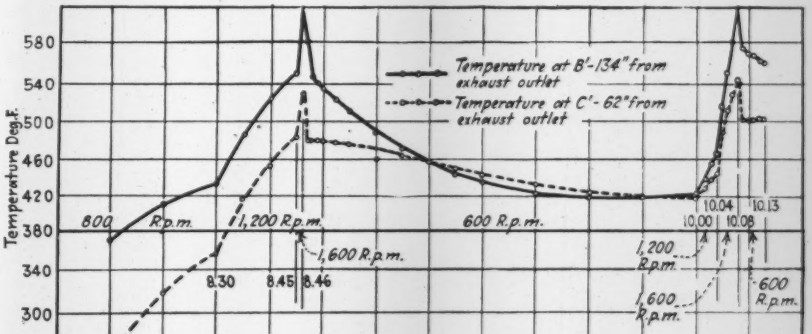
## Oil trailer, buckets and oil-heating pot done away with in Los Angeles County by exhaust-heated oil truck and direct spraying

By W. W. Shelby
*Engineer, Los Angeles County Road Department, Los Angeles, Calif.*

IN PATCHING with hot oils it has been the custom to pull a four-wheel, insulated trailer containing hot 90 per cent asphaltic road oil behind a maintenance truck of about 4-ton rock capacity. Hot oil was drawn from the trailer into buckets and reheated in an oil pot. From this pot it was sprayed onto the patch.

It was found by tests that in the insulated trailer, oil at 420 deg. at 7 a.m. dropped to 350 deg. during the eight-hour shift, with only 50 gal. remaining in the trailer out of 400 gal. provided at the start. It was found that 90 per cent asphaltic oil could be spread satisfactorily at 335 deg. but better at 340 deg. It was then obvious that the hand oil pot could be dispensed with by attaching a hand pump to the trailer, and that if this were not entirely satisfactory, the temperature could be held somewhat higher by additional insulation to the trailer. Concerning the hand oil pot, it was found that about 15 deg. was lost in transferring the oil from the trailer by buckets, and that the average temperature of the oil after reheating varied from 375 to 450 deg., the average being

Fig. 1 — Temperature curves obtained in preliminary tests of exhaust gases in jacket pipe for oil lines.



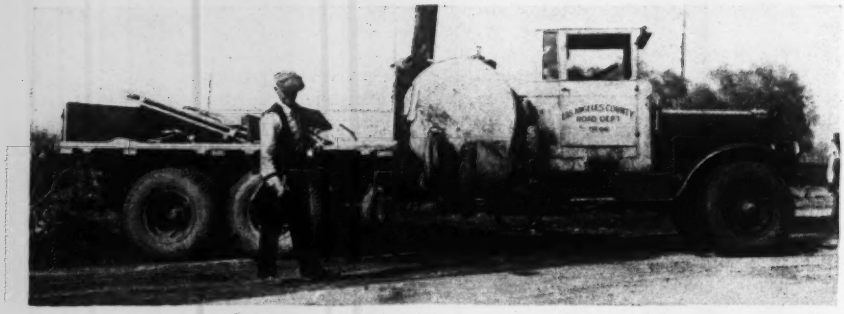


Fig. 2—Truck carrying oil-spraying tank (heated by motor exhaust) and body for stone, used for road patching in Los Angeles County.

about 380 deg. when patching was continuous.

It appeared then that if the trailer tank could be mounted on the truck, and the heat of the exhaust gases from the motor utilized to maintain the temperature of the oil, or to prevent an appreciable drop in temperature, both the trailer and the oil pot could be eliminated. This would result in a more flexible unit, one that could patch isolated holes without loading and unloading an oil pot, one that could travel faster (since no trailer would be attached), and one that would reduce the daily cost of labor performed by the two men required to fill, move and operate the pot.

The design worked out called for an insulated oil tank of 375-gal. capacity mounted crosswise immediately back of the truck cab. The oil was to be sprayed by means of a power-driven pump such as is used in the ordinary pressure distributor, the pump being operated from the cab by the truck driver. The outlet from the tank was carried along the chassis and under the body to the rear end and back again to the tank, thus making it possible to circulate the hot oil through this line at all times. Two hose connections were made on the line, one at the rear of the truck and another near the tank. This double circulating line was inclosed in one pipe, and this pipe was insulated; exhaust gases from the motor could be thrown in direct contact with the oil lines by passing between them and the surrounding pipe. The proper area was calculated so that no back pressure occurred at the motor. It was also planned to heat the oil tank as well as the discharge line by passing a coil through the tank.

## Results of tests

Before ordering this unit a truck of the size desired was equipped with a double pipe inclosed in one outer insulated pipe, which was connected to the exhaust of the engine and which would correspond to the oil-discharge line described above. Two thermometers were inserted through the outer insulation and pipe to the discharge gas chamber at different distances from the engine. From these thermometers a chart was made (Fig. 1), showing exhaust temperatures of the motor at various speeds. It shows that at 600 r.p.m. idling speed only 420 deg. could be expected, but that at running speeds to and from work and during any trips for rock a very decided heating action could be obtained. Based on this chart and the other data described, a specification was written.

On delivery of the truck (Fig. 2) various tests were made. All temperatures were taken by a thermometer in a recess in the tank 11 in. above the bottom. These temperatures are shown on chart Fig. 3.

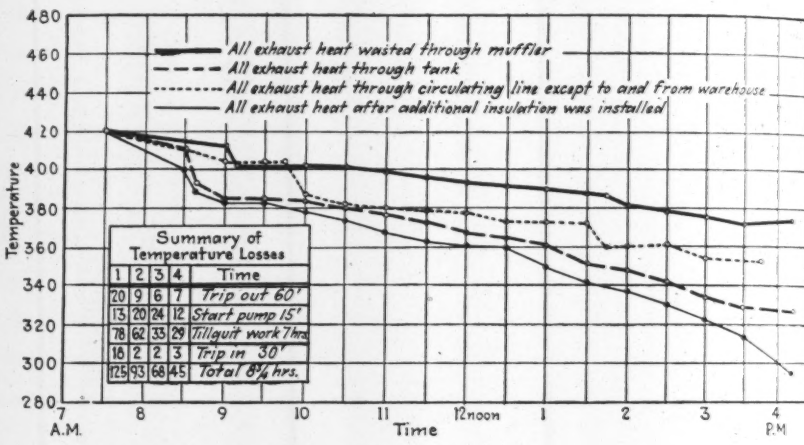



Fig. 3—Curves of oil temperatures in patching truck during working day, with exhaust gases passed through heating system in various ways.

Curve 1 was obtained with this unit operating as an ordinary truck, and hence with all exhaust gases passing through the muffler, no attempt being made to utilize the heat. It shows a total drop of 125 deg. and that the unit would be of no service after 1:30 p.m., using 340 deg. as the satisfactory oil-spreading temperature.

Curve 2 shows operations with the exhaust passing through the tank and not along the discharge or circulating lines. This is some improvement over the non-utilization of the gases, but as the truck is idling about 80 per cent of the time, reference to the chart on exhaust temperatures shows that little could be expected from a gas temperature of 420 deg. However, from 3:30 to 4:15 p.m., the time required to travel from field to warehouse when traveling at normal running speed, the effect of the higher temperature of the exhaust gases is obvious. Nevertheless this method of utilizing the heat of the gases is not satisfactory, as the truck would lose its usefulness at 2:45 p.m.

Curve 3 shows exhaust gases passing along the oil-circulating line to the rear of the truck during all idling time, and through the tank when traveling at ordinary road speeds. This proved to be the combination most desirable to utilize the maximum percentage of the heat in the exhaust gases. This process still shows a drop of 68 deg., although no temperature is below 350 deg., which is a good spreading temperature. However, the margin is small and may not be sufficient to cover lower initial temperatures or colder weather. Hence an additional inch of insulation was applied to the tank and was covered with sheet steel, the steel over the original insulation not being disturbed.

Curve 4 represents the performance of the unit as it now exists, having been in operation almost a year. The daily utilization of the gases is the method just described under curve 3. The total drop is only 45 deg., and the oil is actually heated on the return trip to the warehouse, the amount remaining in the tank being usually small. It will be noted that the total drop in this equipment has been reduced from 125 to 45 deg. by insulation and by using the heat of the truck exhaust.

On analyzing curve 4 it is observed that at 9 a.m. a drop of about 10 deg. occurs in 10 min. This is explained by the fact that oil that is not agitated stratifies as to temperature and that the pump was just circulating in preparation for patching. The true temperature is then shown at the bottom of the drop. It will be observed further that from this point throughout the rest of the shift the drop in temperature is fairly uniform, but there is a slightly greater drop per unit of time as the tank

is emptying itself. From 11:30 a.m. to 1:45 p.m. oil was not circulated. Hence the drop that immediately follows this time again represents the starting of the oil pump. The analysis of curve 4 is applicable to the other three curves.

### Reduced crew

Our paved-way patching crews, employing the old equipment, used six laborers, a foreman and a truck driver. Of the six men the two connected with the oil pot were transferred to other work, thus reducing the labor $9 per day, or about 23 per cent. The initial cost of this equipment is about $1,500 more than the old 5-ton (net load) truck, trailer and oil pot. The $9 per day saving will liquidate this difference in about seven months. The new equipment will carry, in addition to the oil, 7 tons of rock. We find that not only as much work is done, but actually more tons of rock are used per day with four laborers than with six under the old conditions. This is possible because no time whatever is lost. When the truck arrives on the job with a load of rock, hot oil is immediately available.

Acknowledgment is made to F. H. Joyner, consulting highway engineer, for the photograph. N. H. Templin conducted the experiments and collected the data. The writer is especially indebted to H. D. Vreeland, warehouse foreman, for valuable details of design.

# Check Levels Made on Fort Snelling-Mendota Bridge

By Walter H. Wheeler
*Consulting Engineer, Minneapolis, Minn.*

LEVELS taken on the sidewalks of the Fort Snelling-Mendota bridge (*ENR*, March 31, 1927, p. 514), before it was opened in 1926 and again recently, reveal that no pier settlement has occurred and that flow in the concrete, if any, has not been important. The bridge is a rib-arch structure of reinforced concrete, 4,119 ft. long over all, consisting of twelve full arch spans 304 ft. c. to c., one three-quarter arch span and a short approach of column and slab construction. Just prior to opening the bridge on Nov. 6, 1926, check levels were run on the sidewalk on both sides, one line of levels being taken at the top of the curb and the other at the base of the hand-rail; the roadway was also cross-sectioned.

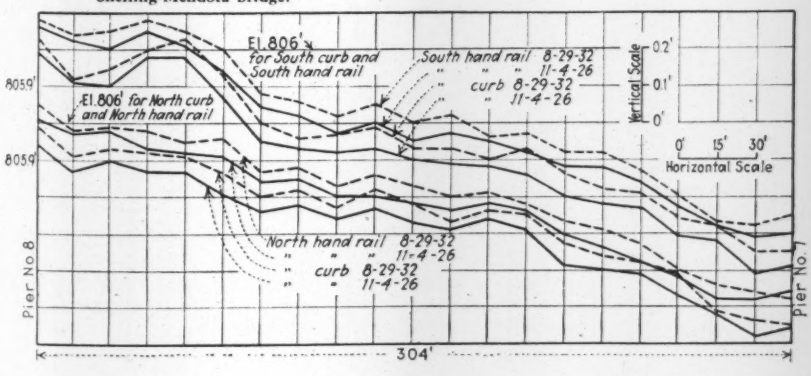
To determine whether or not any changes had taken place in the elevations on the bridge, new readings were taken on both sidewalks on Aug. 27 and 29, 1932. The same benchmark was used as in the original work. The mean of the high and low temperatures on Nov. 4, 1926, was 37½ deg. F., and the mean of the high and low temperatures on Aug. 29, 1932, was 81 deg. F., a difference of 43½ deg. The greatest variation found at any point from the original elevations was about 0.1 ft.

The original levels were run with a heavy railroad location transit, and the check levels were run with the same instrument. The distance between turning points varied from about 600 to 900 ft., so that the longest sights taken were about 450 ft. The readings were read from the rod by the transit man without the use of a target. The accompanying chart shows the profiles as platted from the elevations of 1926 and 1932 for the span between piers 7 and 8, and it is typical of the profiles of all the spans. As the bridge is about 120 ft. high above the water level, the difference in temperature between Nov. 4, 1926, and Aug. 29, 1932, would account for a rise of about 0.035 ft. at the piers and about the same rise at the center of the span. It will be noted from the chart that if correction is made for the difference in temperature, the profiles of 1926 and the profiles of 1932 will be in close agreement.

There has been much discussion concerning flow in concrete under stress, resulting in deformations which in some cases might be serious, but this investigation does not indicate that there has been either settlement or deformation in the structure since its completion.

The main piers of the Fort Snelling-Mendota bridge consist each of four cylinder caissons of reinforced concrete sunk to bedrock by open dredging and sealed under water. The depth of these piers ranges from 55 to 90 ft. below the surface, and this investigation would indicate that the method used for sinking and sealing the caissons can be relied upon under similar conditions, as there is no indication of any settlement whatever in the six years that have elapsed since the bridge was completed.

**Comparative profiles on sidewalks of Fort Snelling-Mendota bridge.**




## Smooth Surface Specified for New York Cement-Grouted Road

Specifications for the mile trial section of cement-grouted macadam to be laid by New York State near Newburgh (bids called for Oct. 4) require a high degree of smoothness of surface. Both before and after grouting there must be no variation of more than ¼ in. under a longitudinal 16-ft. straightedge.

A slab 18 ft. wide and 6 in. thick is called for, with longitudinal dummy joint of 1x2-in. yellow pine strip set vertical and 1 in. pre-molded transverse joints about 300 ft. apart.

Stone is to be of one size, about 2-in., spread and rolled in one layer wherever possible (one-third is on five per cent grade); grouting is to be done in a single operation for the full thickness in all cases. The stone is to be spread by a blading machine weighing 13,000 lb. and rolled to 6 in. thickness with a 10-ton power roller before grouting. Grout is 1:2, mixed to the consistency of thick cream, and is to contain 2 lb. calcium chloride per sack of cement. It is to be applied from a truck mixer by a chute or spout with a head producing separate vertical streams.

Immediately after grouting the pavement is to be given an initial rolling to facilitate penetration, and after about 20 minutes it is to be given final rolling. The surface is to be finally broomed.

The principal items of the engineers' estimate are:

| Item | Unit Price | Amount |
|---|---|---|
| Excavation 4,000 cu. yd. | 0.50 | $2,000 |
| Trimming shoulders, 5,050 ft. road | 0.05 | 252 |
| Preparing subgrade, 10,100 sq. yd. | 0.10 | 1,010 |
| Cement, 1,680 bbl. | 2.45 | 4,116 |
| Center joint, 5,025 ft. | 0.02 | 100 |
| Transverse joint, 360 ft. | 0.10 | 36 |
| Cement-bound macadam, 10,000 sq. yd. | 0.80 | 8,080 |
| | | $15,595 |
| | Bridge | 2,328 |
| | | $17,923 |

# Floating Sludge Reduces Digestion-Tank Gas Yield

**During cold weather the floating material remains cold and inactive despite tank heating—Excessive tank temperatures appear to retard gas production—Notes on operation of new Rome, N. Y., sewage plant**

By Henry W. Taylor
*Consulting Engineer, New York City*

A HALF-YEAR'S operation of the new sewage-treatment plant at Rome, N. Y., has yielded valuable information regarding sludge digestion. Serious difficulties were encountered shortly after the plant was put into operation from yellow floating sludge, which digested very slowly and interfered with the uniform production of gas. Jets of supernatant liquor directed onto the surface of this sludge have served to keep it under control. Gas production was found to be greatly affected by the addition of fresh sludge to the digesting material. Experiments on sludge concentration before digestion indicate the desirability of such a process.

The new sewage plant at Rome was described in an article in *Engineering News-Record* in the issue of May 12, 1932, p. 685. The plant consists of three shallow settling tanks equipped with parallel sludge scrapers, a separate sludge-digestion tank provided with heating coils, a sludge-storage tank, a sludge-drying bed, and an outfall sewer to the New York State barge canal.

There are three rectangular settling tanks, each 35x90 ft., with a 7-ft. average depth of sewage. The bottom of each tank is sloped 1 ft. in its length to a sludge pocket at the inlet end. In these tanks there are two parallel sludge collectors with 16-ft. sweeps, which return as skimmers at the surface of the sewage.

Power consumption for the entire plant, including pumping of flushing water, sludge and supernatant liquor, recirculation of sludge, occasional dewatering of the tanks and operation of the sludge-scraper apparatus, averages less than 10 kw.-hr. per day. The sludge scrapers are operated twice a day, once in the morning and once in the afternoon. The average fresh-sludge withdrawal is 30 cu.ft. per 1,000 population per day.

The following table contains data regarding operating results. As no laboratory régime has yet been established, there have been no composite samples of influent or effluent collected, but the data shown are of interest as showing uniformity of results. The sewage effluent is superior in physical appearance to the water of the barge canal into which it is discharged. The flow in the canal is 200 sec.-ft.

The sludge-digestion tank is of concrete, 48½ ft. in diameter, with walls 21 ft. high from the high point of the hopper-bottom floor. The tank is equipped with two 2-in. copper heating coils with welded joints, located at about the center of the tank's height, and with a floating cover for gas collection. A gas-burning water heater installed in the control house contains six burners, each having a capacity of 80 cu.ft. of gas per hour.

On Nov. 1, 1931, pumping of sludge to the digestion tank was begun, and for the first six months of operation the floating cover was maintained in the position of about 18 ft. above the tank bottom.

DATA ON OPERATION OF ROME SEWAGE PLANT

| Month | Outdoor Temp. Daytime Max. | Outdoor Temp. Daytime Average | Outdoor Temp. Daytime Min. | Settleable Solids by Imhoff Cone, p.p.m. Influent | Settleable Solids by Imhoff Cone, p.p.m. Effluent | Relative Stability of Effluent No. of Tests | Relative Stability of Effluent Days | Daily Average Fresh Sludge, Cu.Ft. | P. H. of Sludge | Lime Added, Bags | Millions B.t.u. to Dig. Tank | Tanks Cu.Ft. Gas Mo. | Tanks Cu.Ft. Gas Average Daily |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dec. '31 | 45 | 31 | 14 | ... | ... | ... | ... | ... | 6.9 | 34 | 93 | | |
| Jan. '32 | 58 | 33 | 10 | 2.1 | 0.4 | 3 | 16 | 684 | 7.2 | 60 | 130 | 82 | 2 6 |
| Feb. | 41 | 26 | 5 | 2.6 | 0.2 | 4 | 9 | 720 | 7.3 | 24 | 84 | 129 | 4 5 |
| March | 46 | 33 | 23 | 3.9 | 0.2 | 4 | 7 | 741 | 7.5 | 0.5 | 96 | 201 | 6 5 |
| April | 62 | 44 | 32 | 3.4 | 0.2 | 4 | 9 | 796 | 7.4 | 1 | 132 | 305 | 10 2 |
| May | 78 | 63 | 45 | 3.6 | 0.1 | 3 | 10 | 827 | 7.6 | .. | 119 | 396 | 12 7 |
| June | 78 | 69 | 57 | 3.0 | 0.06 | 3 | 10 | 839 | 7.7 | .. | 53 | 516 | 17 2 |
| July | 82 | 74 | 59 | 4.4 | 0.14 | 4 | 8 | 986 | 7.7 | .. | 52 | 745 | 24 0 |
| Average | .. | .. | .. | .. | .. | .. | .. | 800 | .. | .. | .. | .. | .. |

## History of tank operation

The accompanying charts, together with the table, tell the history of the operation of the digestion tank.

When the plant was first started up two kerosene burners were installed under the water heaters and were put into operation on Dec. 8, 1931. Accurate temperature readings of the sludge were made, starting on Jan. 1, 1932.

After Jan. 1 the sludge temperature increased rapidly, accompanying by increasing gas production. It will be noted that the high temperatures obtained in June, reaching at times more than 90 deg., were not favorable to gas production. The optimum temperature appears to be between 78 and 84 deg.

When sufficient gas was being produced, the kerosene burners were removed and the gas burners put into operation. During the change-over period the tank temperature became slightly unstable. The total kerosene consumption during the starting period, from Dec. 8, 1931 to Feb. 15, 1932, was 3,160 gal. for a tank of 40[illegible]-cu.ft. capacity.

The original pH value of the raw sewage was 6.9. Sufficient lime was added to raise the pH to 7.4. Since this original conditioning, practically no lime has been required, and the pH value maintains itself without assistance. The field tests of pH are no doubt high due to the turbidity of the liquors tested.

During December, 1931, it was noted that a thermometer placed directly beneath the floating cover was registering the temperature of floating sludge or scum rather than the temperature of the supernatant liquor. Accordingly from Jan. 1 the practice was adopted of taking three temperatures, that of the top sludge, of the supernatant liquor at half-depth of the tank, and that of the bottom sludge.

In February it was noted that the cover was floating very high above the water level in the tank. On Feb. 18 this freeboard amounted to 27 in., compared with the normal of about 9 or 10 in. This indicated the accumulation of a large volume of floating sludge, which was floating the cover. To meet the situation, this scum was agitated with hot supernatant liquor, during which time fresh sludge was pumped to the sludge-storage tank. A short while later a jetter was installed in the gas dome of the cover.

When this accumulation of floating sludge occurs, the top sludge cools, and the recording thermometer reading drops rapidly. On March 11 a fourth temperature reading was instituted, so that after that date temperature records were made of the floating sludge, top supernatant, middle supernatant and bottom sludge. When cold, the floating sludge remained inactive. The notes on the chart indicate the results of jetting in improving top-sludge temperatures, the gradual improvement during May and the final effect of summer heat, increased activity in the whole sludge body and rising gas production.

The depression in the gas-production curve in March was due to two causes: (1) the cooling off of the floating sludge, which retarded digestion as far as this sludge was concerned; and (2) the delayed effect of temporarily starving the digestion tank with the fresh sludge while remedying the floating-sludge condition.

High temperatures during May ap-

parently retarded gas production, and the tank temperatures were thereupon reduced.

During cold weather the temperature of the floating sludge was many degrees below that of the supernatant liquor. When warm weather arrived, the situation was reversed. In June the floating sludge attained a temperature of more than 80 deg., which was followed by such an increased rate of gas production that the dome seal was blown and the relief burner was overtaxed. The excessive agitation thinned out the bottom sludge by raising it and interfering with settlement. When the tank temperature was reduced, this condition was relieved, and the bottom sludge thickened to its original consistency. A better regulated gas production was obtained, high in quantity but not disturbing to the digesting sludge. It should be remembered that up to this time a large quantity of fresh sludge had been pumped to the tank, and only a small quantity of digested sludge had been removed.

### Withdrawal of sludge

The first digested sludge was drawn from the tank on April 14. The tank had first received fresh sludge on Nov. 1, 1931, and it is believed that by Jan. 1 all of the sewage with which the tank had been filled was displaced. Active digestion probably did not occur until later because of the low tank temperatures that prevailed until March. The first digested sludge drawn off was satisfactory in color and consistency. It drained quickly and dried with little difficulty under unfavorable weather conditions. The depth of sludge run upon the lower end of the drying bed was about 14 in., which drained and dried to a cake of about 4 in. in thickness.

During May frequent sludge withdrawals were made, and the total for the month was 11,000 cu.ft. Withdrawals during June totaled 23,905 cu.ft.

Before digested sludge could be withdrawn, the supernatant liquor was delivered to the settling tank. For a long time this liquor maintained a yellowish color but eventually changed to the characteristic black with black flocs, which readily coagulated and settled.

During March, when difficulties were experienced with floating sludge, fresh sludge was pumped from the storage tank, and a small quantity was allowed to remain there. No attention was paid to it until July. It was then found that a mold about 1 ft. thick had developed on top and, though some digestion had taken place, the bulk of the material appeared to be inert. Shortly after digested sludge was run to the storage tank in July, the mold disappeared quickly, and the whole mass softened and become active. In about three weeks a very satisfactory digested sludge was withdrawn from the storage tank.

Following this experience, the storage tank was three-quarters filled with a combination of floating sludge, supernatant liquor and digested sludge. The temperatures prevailing in the unheated storage tank have not been far below the temperatures in the digestion tank. Frequent withdrawals of the floating sludge from the digestion tank have materially aided in its operation.

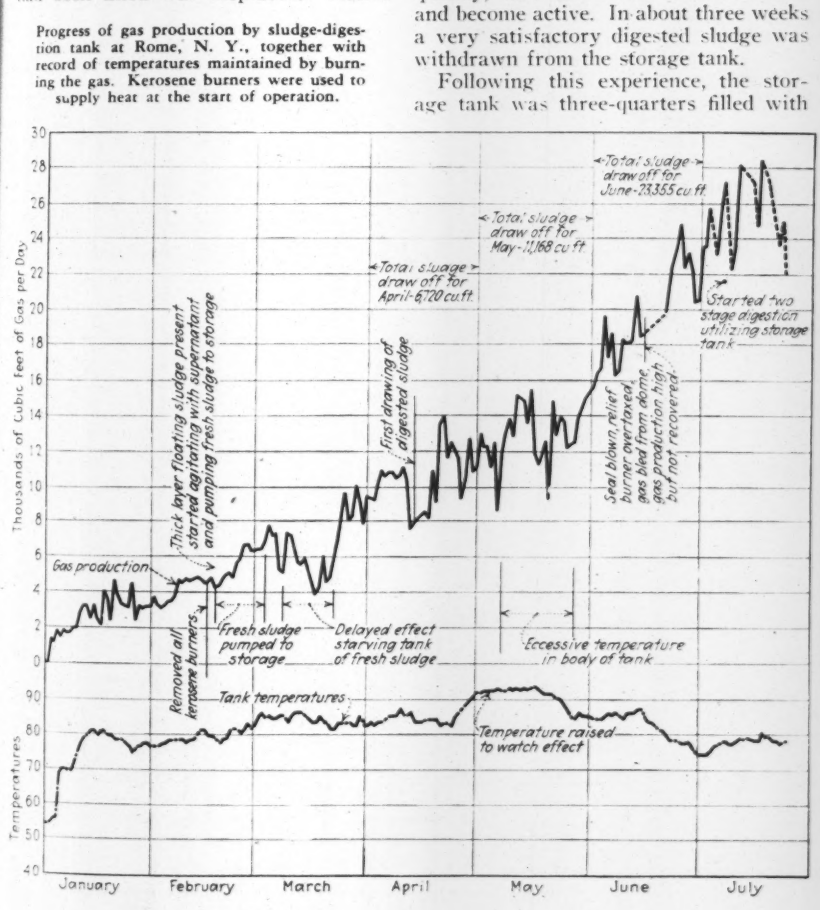
### Tests on sludge concentration

A considerable amount of work has been done to determine the feasibility of concentrating fresh sludge prior to pumping it to the digestion tank. The experiments have shown that the sludge concentrates quickly to something less than 70 per cent of its initial value. The concentration must not, however, be allowed to take place under exposure to the summer sun. It is believed that it could readily be accomplished in a covered tank within three hours.

For the settling tank 8-in. sludge-blow-off piping has been found to be unnecessarily large. The sludge must be drawn off slowly in any event, and an 8-in. valve can be opened only a small fraction of its total capacity. The head required for the blowing of sludge at Rome averages about 6 in.

No stoppage of sludge piping has been experienced. There have been several instances, however, when rags in the bottom of the sludge pocket have interfered with the blow-off. This suggests the desirability of having a sludge pipe supported from the top to avoid the obstruction of the supporting foot at the bottom.

**Progress of gas production by sludge-digestion tank at Rome, N. Y., together with record of temperatures maintained by burning the gas. Kerosene burners were used to supply heat at the start of operation.**


Thousands of Cubic feet of Gas per Day
Temperatures
Total sludge draw off for June-23,355 cu ft.
Total sludge draw off for May-11,168 cu ft.
Total sludge draw off for April-6,720 cu ft.
Started two stage digestion utilizing storage tank
Thick layer floating sludge present started agitating with supernatant and pumping fresh sludge to storage
first drawing of digested sludge
Seal blown, relief burner overtaxed, gas bled from dome, gas production high, but not recovered
Gas production
Removed all kerosene burners
Fresh sludge pumped to storage
Delayed effect starving tank of fresh sludge
Excessive temperature in body of tank
Tank temperatures
Temperature raised to watch effect
January
February
March
April
May
June
July

## B. Coli in Spring Water Due to Salamanders

Salamanders, lizard-like amphibians, have been shown to be responsible for the presence of colon bacilli in water obtained from springs otherwise free from bacterial pollution. A description of laboratory experiments and field studies on "Salamanders and Water Hygiene" appeared in *Natural History*, Vol. 33, No. 3, 1932, pp. 303-310. Controlled experiments in the laboratory showed that one salamander excreted a sufficient number of colon bacilli per day to contaminate 237 gal. of water heavily enough to be considered dangerous for human consumption. It is believed that salamanders act as reservoirs or incubators, and having once been infected with B. coli through their feeding habits while away from the spring, continue to excrete them as long as there is material in the salamander's stomach or intestines to supply nourishment to the bacteria. Autopsies performed during the summer showed a marked increase in the amount of food and the number of colon bacilli in the stomach and intestinal tracts. It is concluded that salamanders play an important role in causing certain water supplies to appear polluted, thus making it difficult to interpret the evidence of contamination.

# Delay in Planning Buildings Now Means Extra Cost

## Evidence of bottom in building costs warns owners that delay in planning construction will require heavier investments for needed improvements

By M. D. Eams and W. S. Wolfe
*Building Cost Estimator and Chief Structural Engineer, Smith, Hinchman and Grylls, Detroit, Mich.*

NO ONE denies that during the five years from 1927 to 1931 this country became oversupplied with buildings, and at a high cost; but that fact does not justify the belief prevalent in some quarters that no more new building construction will be required for the next ten years. Rapid and constant change is on the program now as it was five years ago, and the building that was appropriate in shape, size type and location then may today or next year be wholly unsuited for profitable use because of failure to retain its favorable position in any one of those characteristics.

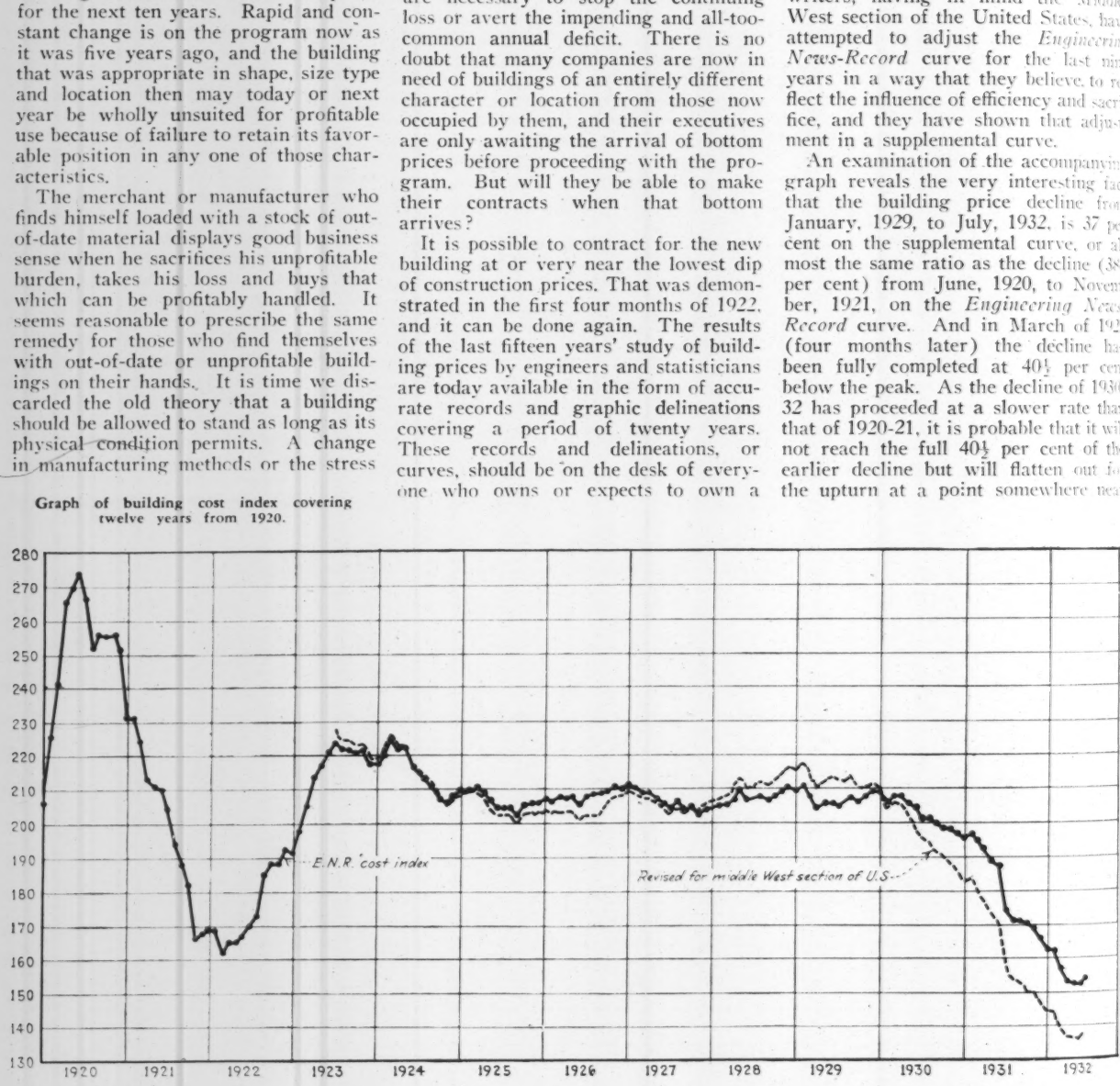
The merchant or manufacturer who finds himself loaded with a stock of out-of-date material displays good business sense when he sacrifices his unprofitable burden, takes his loss and buys that which can be profitably handled. It seems reasonable to prescribe the same remedy for those who find themselves with out-of-date or unprofitable buildings on their hands. It is time we discarded the old theory that a building should be allowed to stand as long as its physical condition permits. A change in manufacturing methods or the stress of competition may ruin a building even more effectively than structural failure, and loss of the strategic advantage of locality may work as much havoc as destruction by fire. It is the most important duty of the executive to foresee these changes, or at least to recognize them immediately upon their occurrence, and to take without delay such steps as are necessary to stop the continuing loss or avert the impending and all-too-common annual deficit. There is no doubt that many companies are now in need of buildings of an entirely different character or location from those now occupied by them, and their executives are only awaiting the arrival of bottom prices before proceeding with the program. But will they be able to make their contracts when that bottom arrives?

It is possible to contract for the new building at or very near the lowest dip of construction prices. That was demonstrated in the first four months of 1922, and it can be done again. The results of the last fifteen years' study of building prices by engineers and statisticians are today available in the form of accurate records and graphic delineations covering a period of twenty years. These records and delineations, or curves, should be on the desk of everyone who owns or expects to own a building. Among the many publish curves on building costs, that of *Engineering News-Record* seems to the wr ers to have been worked out on t broadest and most representative ba and is the one, with modifications to described later, that will be used to sho the serious loss that is likely to res if definite preparations for the ne buildings are postponed further.

The *Engineering News-Record* cur is a composite weighted average of t monthly prices of steel, cement, lumb and labor, and these were selected b cause of their representative characte Obviously it cannot include two im portant elements—namely, labor ef ciency and the builder's sacrifice overhead and profit, which vary wide in different centers of activity, an therefore it must be left to the loc engineer to determine and record the effects on the general curve. Th writers, having in mind the Middl West section of the United States, hav attempted to adjust the *Engineerin News-Record* curve for the last nin years in a way that they believe to re flect the influence of efficiency and sacr fice, and they have shown that adjus ment in a supplemental curve.

An examination of the accompanyin graph reveals the very interesting fa that the building price decline fro January, 1929, to July, 1932, is 37 pe cent on the supplemental curve, or al most the same ratio as the decline (38 per cent) from June, 1920, to Novem ber, 1921, on the *Engineering News-Record* curve. And in March of 193 (four months later) the decline ha been fully completed at 40½ per cen below the peak. As the decline of 1930-32 has proceeded at a slower rate tha that of 1920-21, it is probable that it wi not reach the full 40½ per cent of th earlier decline but will flatten out fo the upturn at a point somewhere nea

Graph of building cost index covering twelve years from 1920.



the present level. Support is lent to this belief by the recent favorable turn (June, 1932) in the price ratio of manufactured goods to raw materials, a turn that is usually accompanied by an increase in employment.

The building price bottom in 1922 was coincident with an increase in construction volume, and the volume in 1922 was 50 per cent greater than in 1921. The thing of utmost significance, however, is the fact that with the increase in volume there occurred a rebound of 37 per cent in building costs, forcing those who delayed their preparations for construction to pay greatly increased prices. If the same cycle is repeated (and it looks probable), many who now, or will soon, need new buildings will be "caught short."

In the decline of 1920-21 the time between the first definite sign of a construction price bottom and the beginning of the increase was four months, just sufficient time to complete preparations for a new building and have the drawings and specifications ready to offer for tenders at the low point. That many took advantage of the golden opportunity is evidenced by the immediate increase in construction volume. However, many waited until the beginning of the upturn before commencing preparations and were forced to pay from 14 to 37 per cent more for their buildings, because during the period of preparation the building market "ran away."

If in the present case the bottom should be delayed four months beyond the anticipated period, the owner with foresight would lose only the interest for four months on that part of the architect's fee due for drawings and specifications, and he would almost certainly gain an amount 200 times as great as the loss. For example: for a million-dollar building the portion of the architect's fee payable for drawings and specifications would probably be $35,000, and the interest on that sum for four months would be $700. An advance of only 14 per cent in the four-month period would be $140,000 off the building mentioned. A year's wait would reduce the probable gain from 200 to 1 down to 67 to 1, and even that is worth the slight risk.

The curve has remained approximately flat for April, May and June; July shows a slight upturn, wages as well as material prices appear to be adjusted, and the indications are now reasonably clear that the bottom of building costs is not many months away and possibly already past. Should the present opportunity be overlooked.

# Unique Dome Design Fixed by Need for Light Members

## Earthquake hazard dictates use of steel framing in Hebrew University building in Palestine—Lack of unloading facilities at docks and erection equipment in the field limits permissible size of members

By Julius Lasker
*Structural Engineer, Boston, Mass.*

PLANS were completed recently for a new building to be erected on Mount Scopus, Jerusalem, Palestine, for the Hebrew University. Officially designated as the Rosenbloom building and designed to supply many needs of the university, the building will also contain an auditorioum which, with the balconies, is to have a seating capacity of 1,200. The building will be not only the largest of its kind so far erected in Palestine but, from the standpoint of architectural and structural design, will be unique in that country where construction is subject to peculiar conditions. Particularly notable is the steel-frame dome that surmount the auditorium.

The earthquake that shook several portions of Palestine in July, 1927, causing the loss of several hundred lives and considerable property damage, demonstrated once again that the prevalent type of construction—stone-masonry walls carrying the loads of floors and roofs—is not safe against seismic disturbances. Yet stone, cement, lime and sand are the only native building materials. All others, even wood and nails, must be imported. This limits to a very great extent the size and weight of the pieces that can be handled, because Palestinian harbors are not yet accessible to steamers. All boats arriving at Haifa or Jaffa must anchor about 2 miles offshore. Passengers and cargo are unloaded into large rowboats, each one operated by two husky oarsmen. Neither is there any machinery worthy of the name for transferring the freight from the rowboat to railroad cars or trucks, and most of this work is done by hand. Furthermore, since the government of Palestine owns and operates the railroads, it does not permit any heavy trucking on the highways. The writer, who has been in charge of large construction work in Palestine for five years, does not recall a single truck of more than 2-ton capacity, with the possible exception of a very few slightly heavier trucks operated by the military.

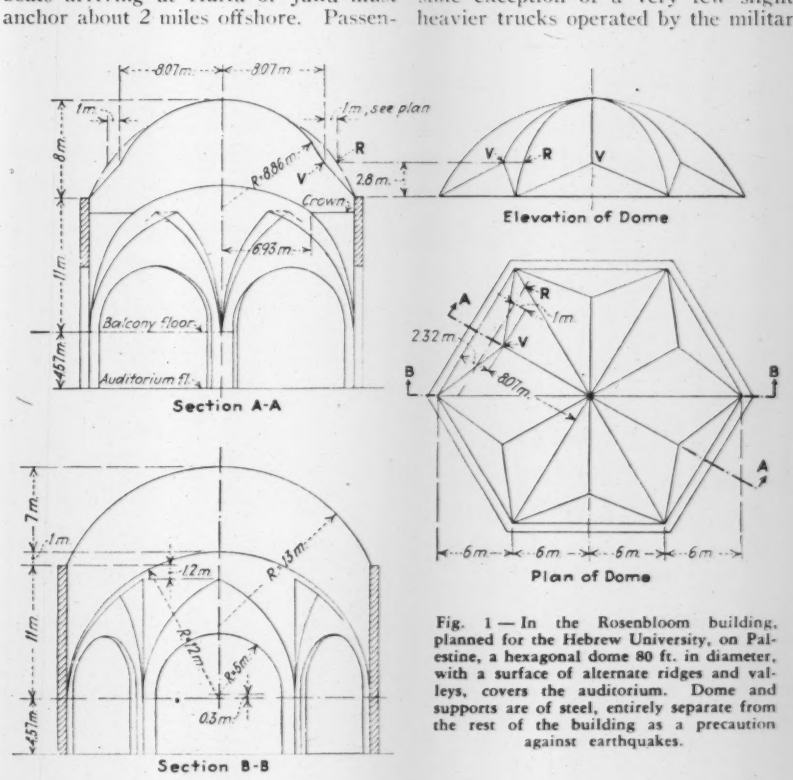



**Fig. 1 — In the Rosenbloom building, planned for the Hebrew University, on Palestine, a hexagonal dome 80 ft. in diameter, with a surface of alternate ridges and valleys, covers the auditorium. Dome and supports are of steel, entirely separate from the rest of the building as a precaution against earthquakes.**

Hence, no piece of structural material shipped from abroad to Palestine may exceed 2 tons in weight, particularly if it is to go to Mount Scopus, which is about 3 miles from the Jerusalem railway station and is reached by a road that has a very heavy grade.

These considerations, which naturally influenced the design of the building generally, were particularly important in the structural design of the dome of the auditorium. This dome covers a part of the auditorium, which in plan is a regular hexagon with sides 12 meters, or 39.36 ft., long, measured on the inner faces of the arch walls. The balconies and the portions of the auditorium under them are outside of this hexagon. In grade and curvature the outer surface of the dome, viewed from above, forms the six-pointed star of David as shown in Fig. 1.

From the top point of the dome there are six circular ridges running to the apices of the hexagon, and six circular valleys that bisect the angles between the ridges, running to the points $V$, the location of which is shown in Fig. 1. The radius of the ridges is 13 m. (42.65 ft.); the radius of the valleys is 8.86 m. (29.06 ft). From each point $V$ down to the face of the arches the dome surface descends in the form of an inclined triangular plane.

The only columns permissible were placed at the apices of the regular hexagon. Because of the danger from earthquakes it was decided to utilize structural steel for the dome framing and the columns. At once there arose the question of the permissible size and weight of the structural members. The lack of proper erection equipment was also a problem. The usual method of steel-dome design by means of a central lantern, with curved ribs radiating from it to the columns, could not be considered because the weight and shape of these ribs would have rendered their shipment, handling and erection impossible under the conditions previously described.

The basic members of the design developed are three trusses, about 80.5 ft. long, spanning between columns on opposite ends of the diameter of the circle circumscribing the hexagon. In plan, then, these trusses are at 60 deg. to one another. By varying the height of the central panels the top chords of trusses 2 and 3 are made to pass just under and clear the top chords of trusses 1 and 2 respectively. The bottom chords are all at the same level and are spliced at the center of trusses 2 and 3, allowing the bottom chord of truss 1 to run through. The top chords of all trusses are wedged at the intersections of their vertical planes, and the trusses are thoroughly braced. The panel lengths are such that no member with all gussets and lug angles riveted to it exceeds 2 tons in weight. Heavy gussets reinforced with bent angles to form brackets at the ends of the trusses fit between the angles of the I-shaped columns and are spliced with the webs.

There are six 24-in. I-beams (Fig. 2) framing between the trusses and supported by them at the proper elevations to receive the lower ends of six 15-in. I-beams, which are in the vertical planes of the valleys. The upper ends of the 15-in. I's are supported by short beams framing between the trusses near the peak.

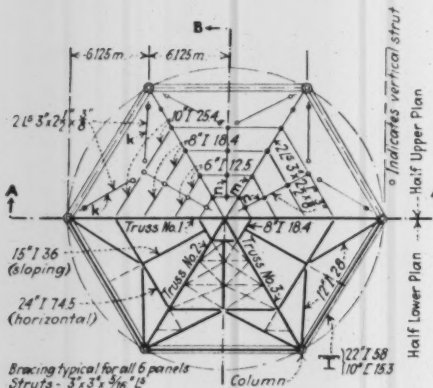
The curved framing for the ridges and valleys is formed by means of light angles carried by angle struts, which frame into the top chords of the trusses and the top flanges of the 15-in. I's, respectively. Adequate bracing is provided in the vertical planes of the ridges and valleys and in plane between them.

The horizontal thrust that a truss brings into a column is taken in tension to the center of the 24-in. I by the inclined 12-in. I's, which support the inclined triangular planes referred to above. The horizontal component of the tension, at right angles to the length of the 24-in. I's is taken up by two rods, 1 in. in diameter, provided with turnbuckles and running between parallel pairs of 24-in. I's, thus balancing the entire system.

In the planes of the arch walls and framing into the columns are compound beams consisting of 22-in. I's with 10-in. channels riveted horizontally on the top flanges. These beams carry the bases of the inclined triangular planes and also brace the columns laterally. The dome is thus made a complete self-sustaining steel structure, independent of the rest of the building.

The inner vault or ceiling is suspended from the dome framing and is to be given acoustical treatment. In the space between the outer dome and the inner vault there are provided catwalks for inspection purposes. Access to this space is by means of windows in the arch walls, which will also serve for ventilating the auditorium through openings concealed in the vault.

The plans for the building were prepared by Taylor & Levi, architects, of New York City. The structural design was made by the writer, who previously had had charge of the construction of some of the earlier buildings at the Hebrew University. Erection is expected to begin soon.



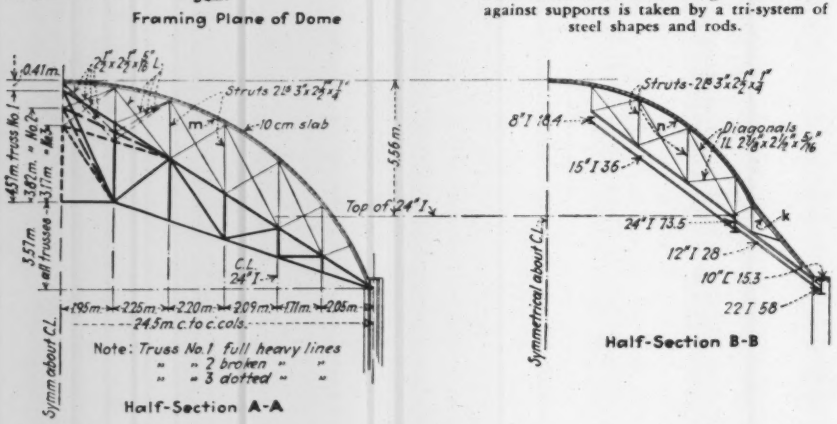




Fig. 2—Steel framing of 80-ft. dome over auditorium at Hebrew University, Palestine, contains no erection piece heavier than 2 tons, which is the capacity of local trucks and erection equipment. Three intersecting trusses form the main framing. Truss thrust against supports is taken by a tri-system of steel shapes and rods.

## Replacing Old Service Pipes

Pavements and lawns are no longer torn up in Baltimore when the gas company finds it necessary to change the pipes entering the premises of consumers. Instead of digging up the old service pipes for their entire length, with considerable damage to streets and yards, the new method involves only a small opening in the paving where the service pipe connects with the main. Through this opening the workmen cut off a 4-ft. length of the service pipe. They also disconnect the house end and attach a length of new service pipe at the point of this disconnection. A pulling apparatus is then used for pulling the old service pipe toward the main, and 3- or 4-ft. sections are cut off at the opening in the paving as the pulling proceeds, while 20-ft. sections of the new pipe are added at the house end. This continues until the entire replacement has been effected. As much as 100 ft. of new pipe has been pulled in this way without disturbing lawn or shrubbery.

# Texas Hydro Plant Built on Irrigation Canal

**Turbines served by double-purpose canal under 81-ft. head—Spillway bypasses excess flow through a stilling pool to the tailrace**

A HYDRO-ELECTRIC plant taking its water from the Rio Grande through a 32-mile irrigation canal is an unusual feature of a combined irrigation and power development near Eagle Pass, Tex. The plant was built for the Central Power & Light Co., San Antonio, Tex. It was completed in May of this year.

As described in an article on the irrigation project in *Engineering News-Record*, Aug. 11, 1932, p. 153, the Maverick County Water Control and Improvement District No. 1 originated an irrigation development and in 1927 was granted a diversion of 600 sec.-ft. from the Rio Grande. Electric utility interests later made a proposition to establish a 13,500-hp. hydro-electric station on the main canal and to purchase its water supply from the District. This development was approved by the Federal Power Commission, and a total diversion of 1,500 sec.-ft. for irrigation and power subsequently was authorized by the Texas State Board of Water Engineers. The combined use of the canal for irrigation and power purposes contributed largely to the economic aspects of both projects.

The irrigation district has no connection with the power company except through the sale of water. Its main canal, which ultimately will be 90 miles long, has been completed for 32 miles and provides irrigation for about 15,000 acres. From the present end of the main canal a headrace canal leads to the power station, situated between the canal and the river, at a point where the main canal is within 1,500 ft. of the Rio Grande and its water level is about 85 ft. above the low-water stage of the river. The irrigation canal to this point has a flow capacity of 1,500 sec.-ft.; on the future 60-mile extension for irrigation the capacity will be 500 sec.-ft. A minimum supply of 1,250 sec.-ft. is to be delivered continuously for power during the first ten years and 1,000 sec.-ft. during the next 40 years.

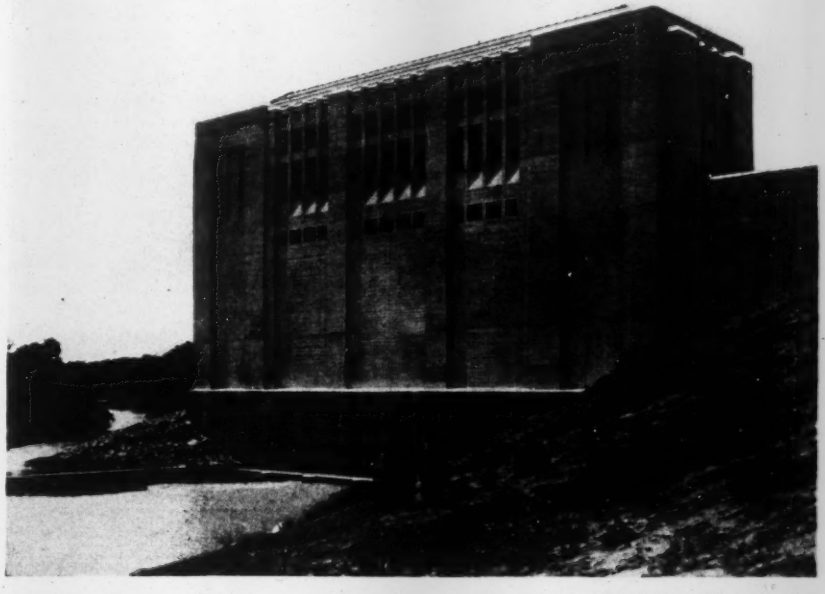
## Power development

Two factors determining the location of the power plant were the short distance between the canal and the river and the existence of a spur or ridge of heavy clay extending to within 200 ft. of the river at about headwater elevation. The latter made it possible to build the headrace canal along the spur, thus reducing the length of the penstocks. A governing condition in the design of the project was that there is no pondage along the canal, so that it is impracticable to operate on variable load or to shut down a unit (except momentarily) when water is available. To take care of excess water during a shutdown, a spillway was built in the outer end of the headrace to pass excess water to the tailrace.

Since all water available for power must be paid for, whether utilized or wasted, it was imperative to insure maximum operating reliability. Therefore, three power units were installed, so that one may be shut down for inspection or repair during periods of low flow.

At the power-house site the river ranges from El. 712 at low water to El. 750 at extreme high water. The interior of the power house is protected against water to El. 760, which is the level of the generator floor.

Power station of the Central Power & Light Co. built on the Maverick County Improvement District irrigation canal in Texas.

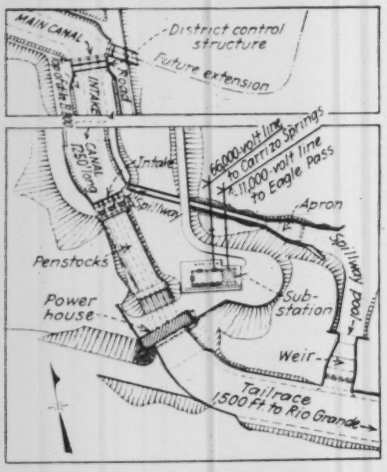


## Headrace and intake

At the diversion from the main canal the irrigation district constructed concrete headworks having four openings 16 ft. wide equipped with vertical truck-type gates operated by hand hoists.

The power plant is located 32 miles below the intake of the irrigation canal.

There is also a check structure across the irrigation canal to maintain a constant headwater elevation. The headrace, 1,250 ft. long, is on the crest of a narrow spur of dense and impervious material. The bottom is in cut throughout, and the water-line also is largely in cut, except across the heads of arroyos or gullies and on low ground near the penstock intake, where embankments 20 to 30 ft. high were required. The ground under the fills was stripped and roughened. Dragline machines built double lines of fills or levees, between which material was dumped in water to form an impervious core. Excess excavation from the headrace was placed on the outer slopes of the fills to increase the stability and the percolation distance.




A 1,250-ft. canal connects the power plant with the main irrigation canal.

For 75 ft. from the intake or forebay the headrace canal has 4-in. concrete lining, as the ridge at this point is no more than wide enough to support the canal. After the canal had been full for two months there was no evidence of seepage.

The intake was designed to reduce entrance loss to the penstocks to a minimum by making the changes in velocity head as gradual and as nearly constant as possible. Transition from the canal section to the intake consists of a base slab with reverse vertical curve and sides with buttressed retaining walls, the faces of the walls being warped from the side slopes of the canal section to the vertical walls of the intake.

Trash racks of round-edged bars welded into frames are placed in grooves in the piers. The three head gates, 14 ft. 7½ in. wide and 13 ft. 3¼ in. high, each rolling on four 18-in. truck wheels, are built up of welded members. Side and top seals consist of a continuous hood of rubber belt on the downstream face, which slides into contact with a ledge on the guide frame when the gate is closed. The bottom seal is of steel on steel, with machine-finished surfaces. Drains on the downstream side carry off gate leakage when the penstocks are emptied, but this leakage is very slight except at rare intervals when a twig or piece of gravel under the hood seal causes a small jet.

Motor-driven gate hoists mounted on steel towers have push-button control from both the intake deck and the switchboard room. Hand cranks provide for operation in case of current failure, while a clutch release at the drums enables the gates to be dropped quickly if necessary.

The tailrace to the Rio Grande is an excavated channel about 1,500 ft. long.

## Buried penstocks

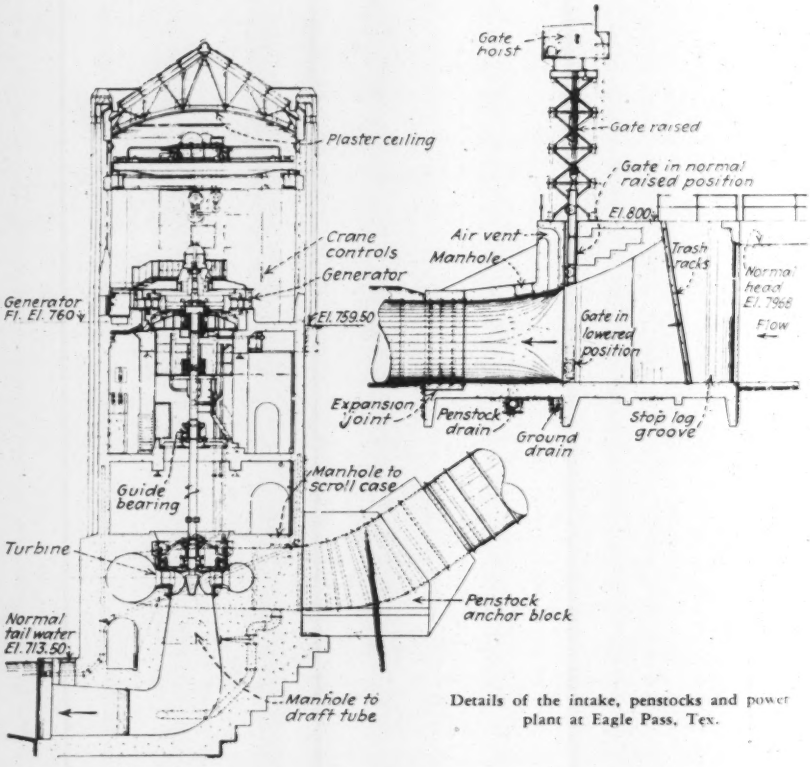
The three riveted steel penstocks are 11 ft. in diameter. With low cost of material and relatively low head, it was found economical to limit the velocity to 6½ ft. per second in order to avoid high friction losses. The tapered portion connecting the penstock with the scroll case was incorporated in the elbow, as the increasing velocity would reduce the tendency of the elbow to create disturbance in the flow.

Readings on net-head piezometers at quarter points on the inlet, taken since completion of the plant, are identical and indicate very little disturbance with this type of elbow. Stiffeners of 5x3x⅜-in. angles are placed 8 ft. apart on the upper section and 4 ft. on the lower section. Transverse joints are double-riveted to take temperature stresses, as the penstocks have no expansion joints or intermediate anchorages.

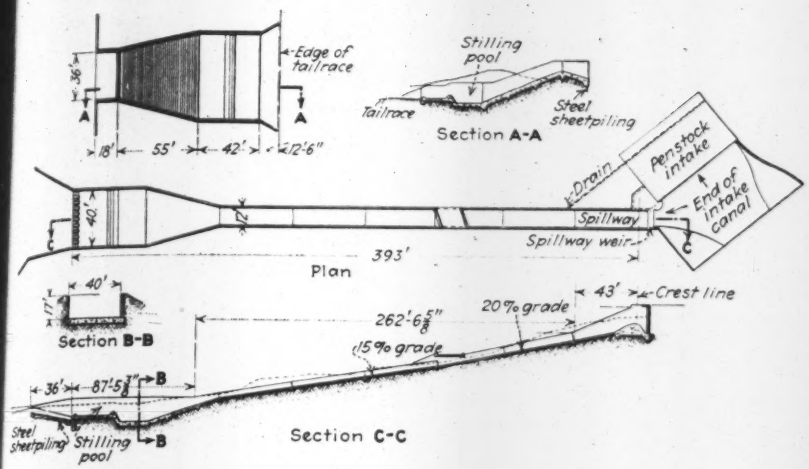
*Air Test of Penstocks*—Since the penstocks were to be buried with a minimum cover of 2 ft. to minimize temperature changes, it was desirable to test them for leakage after erection. Air pressure was used to avoid the necessity of building temporary cradles for supporting the penstocks if filled with water. The turbine scroll case was filled with water to the top of the speed ring, and a heavy timber bulkhead was bolted and calked into the upper end of the penstock. A small compressor gave 5-lb. internal pressure, and a mopping of soap suds on the rivets and seams showed bubbles at the smallest leaks. With this method of testing, leaks could be calked and retested very readily, and it was not necessary to dry the pipe again before painting. After testing, the outside was cleaned by sandblasting and was given a heavy coat of hot bituminous composition. Two coats of hydraulic paint were applied on the inside of the penstock pipes.

## Hydro-electric equipment

The turbines are of the vertical-shaft direct-connected type, with 56½-in. Francis runners, each runner developing, 4,775 hp. when working under 81-ft. head at 225 r.p.m. At this head the discharge of each unit is 615 sec.-ft. The scroll case is of steel-plate construction. Draft tubes are of the curved type, with inspection manholes in the liner immediately below the runner. Galleries at El. 731 give access to the manholes and scroll-case drain valves, as shown in the illustration below.




Details of the intake, penstocks and power plant at Eagle Pass, Tex.




Excess water from the canal bypass the power house through a spillway to the tailrace.

A new feature is the use of a unit lubrication system, greasing all points on the gate stems, links and shifting ring at one shot. From the grease gun, mounted above the pit liner, high-pressure tubing leads to all the fittings. An operator can pump the gun to any desired pressure, with a maximum of 1,000 lb., and an automatic release effects the lubrication at a great saving in time and cost as compared with giving a separate shot to each of the 80 fittings on each turbine.

A new system for packing the gate stems greatly reduced leakage and is expected to lead to considerable change in present designs. The gate shifting ring is on the inside of the pit liner instead of around the bearing as is the usual custom. This arrangement leaves the pit unobstructed and permits ready access to the turbine bearing without dismantling the shifting mechanism.

The generators have a capacity of 4,000 kva. at 0.8 power factor, are of the umbrella type and have a combined thrust and guide bearing below the rotor. Current is generated at 60 cycles, 6,900 volts. Each generator is supported on beams carried by the walls, instead of on a concrete barrel carried by the turbine speed ring. This arrangement proved to be more economical on account of the great height between the turbine and generator floors, while the intermediate floors remain unobstructed.

Cooling air is taken in at the top, near the shaft, and is discharged outward through the generator coils into a steel duct surrounding the machine, the air then passing out through a masonry duct. This system of cooling avoids the discharge of heated air into the generator room except when needed for heating in winter.

## Concrete power house

The power house and substructure are of concrete, founded on a shale formation. The generator room occupies the main part of the building, with the switchboard room at one end. At the opposite end is ample erection space on the three floors, the crane hoist serving the lower floors by means of hatchways.

The 30-ton traveling crane has a 7½-ton auxiliary hoist, and its movements are controlled from the floor.

To prevent isolation of the building at flood stage of the river, retaining walls reaching to the level of the generator floor were extended into the hillside, the space between them being backfilled to form a level area. This backfill is well drained to take care of any seepage. A check valve in the outlet excludes floodwater, any drainage at such times overflowing into a sump, which also receives washwater, turbine pit leakage and other drainage. This sump is served by pumps controlled by float switches.

As noted previously, the normal flow of the canal must be bypassed at the power house in case the turbines are shut down. The bypass spillway has a capacity equal to the maximum flow of 1,500 sec.-ft. It consists of an ogee weir with steel tainter gate 12 ft. wide and 11 ft. deep from which a 12-ft. concrete flume extends down a natural depression into a stilling pool. The total drop is 67 ft. Water flowing from the pool forms a pond in a ravine and then flows over an open-crest weir through a fall of 17 ft. into a second stilling pool that discharges into the tailrace. This second weir prevents the natural drainage from the hills from washing debris into the tailrace.

The stilling pools act successfully in utilizing the principle of the hydraulic jump to destroy energy in the water. Topographic conditions limited the length of the first pool, and the high velocities cause considerable impact and vertical surging at the first baffle. But there has been no erosion below the apron and only a beaching effect above the final weir. This weir, near the tailrace, has a length of 36 ft., giving a wider distribution of flow than at the outlet of the 12-ft. chute. As a result of the loss of energy in the jump, there is no erosion of the gravel bank on the opposite side of the tailrace.

Velocities developed in the longer drop in the spillway are dissipated in a large stilling pool.

## Tainter gate control

The spillway gate is slightly overbalanced by a concrete counterweight on chains passing over sprocket wheels on the overhead motor hoist, which is controlled normally through a float. A small rise in headwater above normal elevation will raise the float and make an electric contact, the gate then opening slightly and breaking the contact. If the water continues to rise, the operation is repeated, step by step. This automatic control can be superseded by push-button control from the switch-

board room or from the platform above the gate.

Normally this gate is held in any position by a solenoid brake acting against the excess torque of the counterweight, but the brake can be tripped mechanically if current should fail at a time when the gate must be opened. To insure further against the gate checking the flow and causing overflow of the canal banks, another means for automatic opening is provided. In one of the side walls is a small chamber communicating with the headrace and having a weir with its crest about 2 ft. below the top of the bank. Should water flow over this weir, it would pour into a bucket on a lever attached to the solenoid brake, the weight tripping or releasing the brake and the gate being raised by the excess load of its counterweight. The speed of the counterweight is restricted to about 2 ft. per minute by a fan directly connected to the driving shaft of the hoist and having a damper in the outlet, thus acting as a brake.

### Hydraulic control

In the switchboard room is a hydraulic control board for operation of the intake headgates, colored lights indicating the positions of the gates. There is also a switch for remote control or automatic control of the spillway gate. Above this board are instruments that indicate and record the headwater and tailwater levels and the position or movement of the spillway gate. Flow meters and manometers indicate and record the discharge of each turbine, each instrument being connected to two piezometers on different radii of the scroll case and thus are actuated by the differential pressure.

The hydro-electric project is the property of the Central Power & Light Co., of San Antonio, a subsidiary of the Central & Southwest Utilities Co., of Dallas, which in turn is a subsidiary of the Middle West Utilities Co., of Chicago. J. T. Persons exercised general supervision for the Central Power & Light, G. A. Mills for the Central & Southwest, and G. W. Hamilton for the Middle West Utilities. With the exception of the substation, which was designed by the Central Power & Light Co., the Harza Engineering Co., of Chicago, handled the engineering of the project. Erik Floor and Jas. S. Bowman were in immediate charge of design, and C. E. Wattles was resident engineer on construction. Bart Moore, of San Antonio, was general construction contractor; turbines were by James Leffel & Co. and generators were by Westinghouse.

# Overpass Aids Traffic in Washington, D.C., Park

**Three-span continuous T-beam structure with cellular abutments on circular cylinders and buttress piers built in Rock Creek Park**

By D. H. Gillette

*Chief, Engineering Division, Public Buildings and Public Parks of the National Capital, Washington, D. C.*

IN THE recently constructed section of the Rock Creek and Potomac Parkway in Washington, D. C., it was necessary to provide an access road down from Massachusetts Ave., (El. 120) to the southbound half of the parkway boulevard (El. 22). The vicinity map (Fig. 2) shows that there were two possible solutions:

(*a*) To descend on the west side of the creek through the old quarry, cross the creek just above the aqueduct dam and enter on the west side of the southbound road.

(*b*) To descend via Waterside Drive (an existing road east of the creek), cross the main northbound road on an overpass, and enter on the east side of the southbound road.

Solution (*a*) in addition to being the more expensive, would have done greater violence to the landscape, involved much steeper grades and necessitated a 90-ft. bridge across the creek. Such a bridge, besides being objectionable as a landscape feature, presented grave difficulties of design because of limited clearance for floodwaters, for which a height of at least 6 ft. above the crest of the dam was required. The dam could not be changed at reasonable expense, as it contains one of the main aqueducts for the city water supply, and to place the bridge downstream from the dam would have involved considerable rock work and a great increase in length of span.

Solution (*b*) involved an undesirable reverse curve in a very constricted space, together with an overpass with a skew of 37 deg., but as this solution required much simpler landscape and architectural treatment and was substantially more economical than solution (*a*), it was selected for construction.

The only feasible location for the overpass itself which would permit of satisfactory connections with the boulevard was approximately as shown on the vicinity map. Upon a detailed investigation of the site it was found that the ground was generally wet (due to springs on the hillside near the north abutment), and that the south abutment came directly over a 7-ft.-diameter brick trunk sewer. A series of borings indicated that solid rock foundation could be obtained at an average depth of 18 ft. below the surface.

The sewer fixed the elevation of the low-level drive, and the requirement as to maximum grade fixed the elevation of the deck. The additional requirement of adequate clearance above the northbound road made the main span of the overpass, from an architectural standpoint, somewhat too flat for its length.

The use of steel would have simplified the engineering problem, but this was excluded because of the adopted policy of making all structures in the parkway simple and natural in appear-

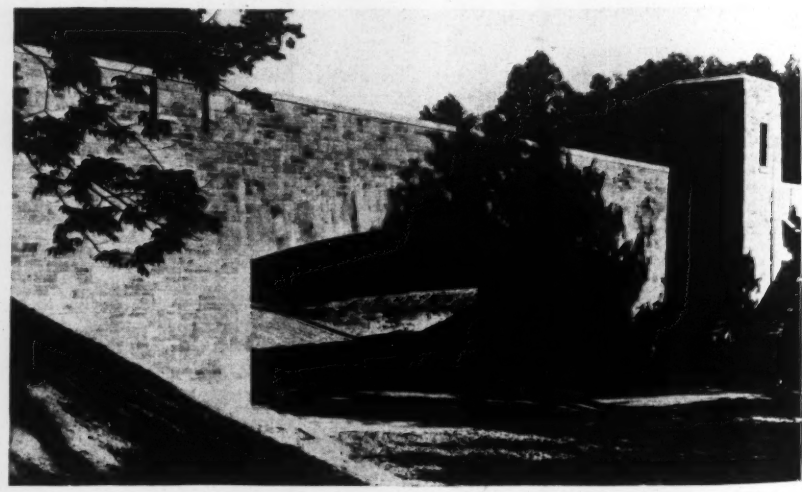


**Fig. 1—Waterside Drive overpass is a concrete T-beam structure faced with stone to simulate an arch or rigid-frame outline.**

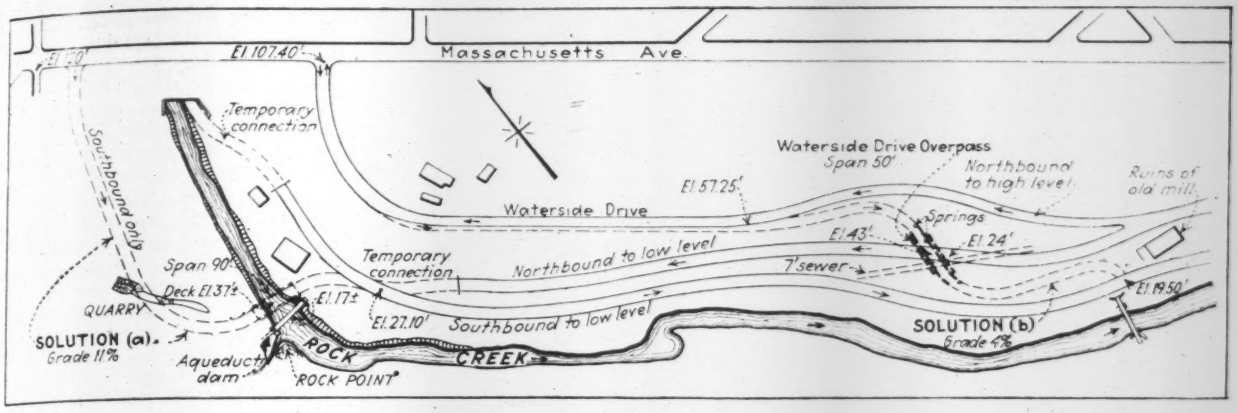



Fig. 2—Of two possible schemes for connecting Massachusetts Ave. with the southbound roadway of Rock Creek and Potomac Parkway, that indicated as solution (*b*) was chosen.

ance. The material that therefore suggested itself as meeting all requirements was reinforced concrete faced with local stone.

The rigid-frame structure was studied at some length but was abandoned because of the distance to a firm foundation; also because of the complication of detailing that would have resulted from the curved approaches and the wet hillside.

The design finally selected consisted of two rigid, cellular abutment structures carried to rock on circular cylinders and rectangular buttress piers, supporting a three-span continuous T-beam girder deck. The central span is 52 ft. center to center of supports, flanked on either end by spans 16 ft. 9 in. long. The cellular abutment structure, of which the south half is shown isometrically in Fig. 3, is fundamentally a counterforted slab retaining wall with extended counterforts tied together at the center. This type of construction offered the most economical solution for stability, both in the wet hillside and in the fresh fill at the south end.

The overhanging end spans of the deck afforded a considerable amount of roofed-over space in each abutment structure; and as comfort stations and storage rooms for park equipment were needed in this section of the parkway, it was obviously economical and also preferable from the landscape standpoint to include these facilities within the bridge itself, making only one structure instead of several to be placed in this narrow strip of park.

The cellular abutment stabilized the wing walls and materially simplified the design thereof but still left the entire structure open to failure because of sliding ground, which might either rotate the abutments about a vertical axis or squeeze the bases of the abutments toward each other. To counteract these two tendencies, several of the foundation cylinders were changed to buttressed piers, proportioned and located to resist such displacement, also the foundation of the pavement of the northbound road passing under the main span was made of a heavy reinforced slab, which ties the two abutment structures together and adds much to the integrity and stability of the foundations. Incidentally this slab was very useful as a stable support for the formwork for the main span, and it showed no settlement whatever during the pouring of the superstructure.

The 7-ft. trunk sewer previously mentioned passes obliquely under the south abutment wall, which had to be carried over the sewer by means of a pair of cylinders capped with a concrete beam to support the wall, as shown in the drawing in Fig. 3.

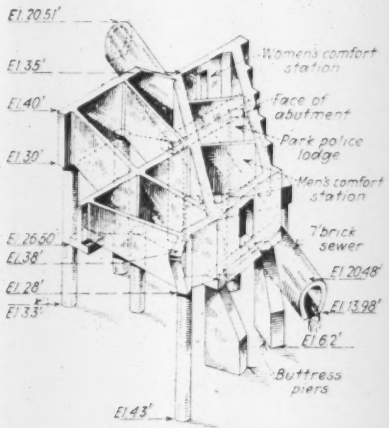



Fig. 3—Isometric view of south abutment with all earth removed to rock. Note buttress piers to resist pressure from wet hillside.

The masonry facing is of a native granitic gneiss of variegated colors, ranging from blue-gray to reddish-brown. Individual stones sometimes show the whole range of colors. Considerable effort was made to prevent a concentration of the same color in any one area and to place colors so as to avoid a spotty appearance. Arch construction was suggested by a ring of voussoir stones considerably longer than most of the other stones in the bridge. Carefully selected large blocks were placed at the springing line to give the appearance of stability.

Another problem was that of the arrangement and bedding of the stones to secure a good appearance. This was worked out according to the rules laid down by Gilmore D. Clarke, landscape architect of the Westchester County Park Commission, which are summarized as follows:

"The larger stones to be in the lower courses with gradual gradation to the smallest ones at the top; stones adjacent to one another to be varied in size and color; beds approximately level with stones bedded on their longest dimension and not more than three stones on one horizontal bed. Stones to be quarry face with natural bed horizontal whenever practicable; joints even width, and no vertical joints over two stones wide."

A brownish sandstone was selected for the coping course of the parapet, as it was impracticable to quarry native stone blocks of sufficient size.

The greatest difficulty experienced in the stone setting was the prevention of prolonged horizontal joints, which was accomplished by having the masons build up in triangular surfaces instead of working to a level string.

As an architectural feature, but also for practical use as a police lookout, a small tower was connected to the west side of the south abutment. It is shown in Fig. 1.

The under side of the main span is lighted by simple glass globes set high in the soffit between the girders. This arrangement furnishes an abundance of light from sources that are practically invisible to traffic and gives a very agreeable appearance at night.

The underpass was designed in the Office of Public Buildings and Public Parks of the National Capital, the detailing being done under the direction of John L. Nagle, designing engineer of the newly completed Arlington Memorial Bridge.

The contractor was The National Construction Co., of Washington, D. C., B. W. Reilly in local charge. The cost of the completed structure was $40,430.

# From Job and Office

*Straightening Building Walls*
*Cast-Iron-Grid Road Surface*
*Concreting a German Dam*
*Surveying Hints*
*Finding Areas from Map Weights*
*Treating Timber After Framing*
*Drawing Room Helps*
*Snow Removal*

❖ ❖ ❖

## Straightening Leaning Building Walls by Jacking Frames

By E. H. Krautheim
*Construction Engineer, St. Louis, Mo.*

THE METHOD employed to draw the wall of a building back into plumb, described in this article, was devised after learning that the replacement cost was not warranted on an old building of its type.

Steel frames were placed at intervals along the outside of the building at right angles to the wall to be plumbed. These

Jacks placed in frames at each floor and roof line bear against steel stringers in forcing building wall back to plumb. Adjustable bolts permit stringers and frame to separate as wall straightens up. Jacks are removed, shims inserted and frames left in place to prevent further wall movement.

frames served as buttresses, being anchored to concrete footings designed to withstand the loads that were applied through screw jacks. The frames were so spaced as not to interfere with entrances into the factory. Stringers were bolted to the frames, parallel to the floor line, opposite the floor and roof rafters. In this position the stringers were brought to bear against the wall at the same elevation with the ends of the floor and roof rafters.

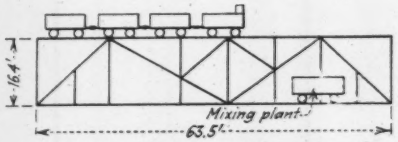
The joints between stringers and frames were made adjustable, so that the stringer could be moved out until the building was back to plumb. At each of these joints there was a trough in which a house jack was so placed that when opened it would bear between stringer and frame. The stringers were cantilevered from the frames by four 1-in. bolts at each joint. As the jacks were opened the bolts were slacked off, allowing the stringers to be moved back.

Twelve 35-ton jacks were operated at one time, which enabled the wall and building to be moved back without serious cracking. The wall at the roof line was pushed back 7½ in., and the gaps that were opened between stringer and frame were filled with shims. This enabled the jacks to be removed, leaving the steelwork in place to prevent any further movement.

The cost of this work was less than 5 per cent of the estimated cost of replacing the walls. The work was completed without interfering with factory operations, as all the work was done from the outside of the building. The actual time for jacking an 86-ft. section of the building back to plumb was three hours. All steel was erected with an 18-ft. hand-operated gin pole, employing unskilled factory labor.

## Novel Concrete Distribution for German Dam

A CONCRETE dam 200 ft. high, 740 ft. long on the crest and 164 ft. long at the base will be completed this year to dam the Saale River near Saalburg, Germany, and form a 2,265-acre reservoir. This reservoir will serve the threefold purpose of regulating water stages in the Saale and Elbe rivers, supplying water to the Mittellandkanal and developing electric power. Construction of the dam was begun in 1925, and concreting in 1930. The dam contains 234,000 cu.yd. of concrete.




Concrete plant mounted on bridge spanning dam.

The concrete plant was installed on a timber-truss bridge set over the dam on concrete piers rising to the crest top and extended above this level with timber. The concrete piers were carried in the dam concrete as this was carried up. The bridge had a span of 63½ ft. and two decks, as shown by the sketch. The lower deck carried the four-mixer mixing plant, and the upper deck carried a track for bringing in the dry batches. Chutes extending down the pier side delivered the mixed concrete to a movable chute that distributed it over the work.

## Farm-Land Areas Determined by Weighing Cut-Out Prints

By Joseph J. Bernstein
*U. S. Engineer Office, Clewiston, Fla.*

IN A recent problem to find the quantities of farm land contained within the reservoir boundaries of a proposed hydro-electric development, much time was saved by cutting out the sections from blueprinted maps and determining their areas by weighing on a sensitive balance. The method proved to be sufficiently accurate for the purpose in hand and was a great deal quicker than planimetering.

Three grades of farm land, designated as grades *A*, *B* and *C*, were involved. Tracings and blueprints of the reservoir were available and were drawn to a scale of 1 in. equals 1,000 ft. The individual parcels of land varied from 1 to 400 acres in size, or, in actual dimensions on the map, from ½ to 16 sq.in.

The work was first undertaken by planimetering the areas on blueprints, making the necessary correction for shrinkage or stretch of paper. After pursuing this method for a few days it was found that progress was very slow. The desirability of employing a more rapid method was evident, and the method of determining the area by weighing was evolved.

Several 10-in. squares were cut from the blueprints and weighed on balances sensitive to one ten-thousandth of a gram, to determine the uniformity in thickness and density of the paper. These variations were found to be small.

The prints were then all cut into 10-in. squares, and each square was cut into *A*, *B* and *C* sections. These plats were weighed by classes and then weighed all together as a check against the sum of the separate weights. As the area of the square was known, the area of each class of land was readily computed by multiplying the total area by the ratio of the weight of the class to the sum of the weights of the various classes.

After several sheets had been classified by weighing one 10-in. square at a time, it was found that little accuracy would be sacrificed and the work would be further facilitated if an entire sheet were classified at once. The variation

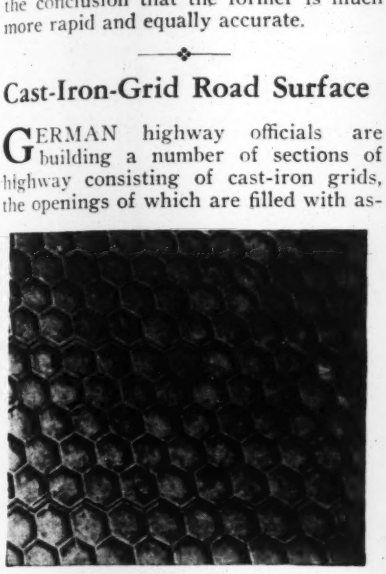
in the thickness of the paper from one square to another was the only factor tending to reduce the accuracy. This error was found to be small.

In carrying out this scheme the reservoirs were inclosed in regular geometrical figures whose areas were readily computed. The area of each class of land was then computed by multiplying the area of the composite geometrical figure by the ratio of the weight of that class to the sum of the weights of all the classes.

A comparison of the weight method with the planimeter method resulted in the conclusion that the former is much more rapid and equally accurate.

## Cast-Iron-Grid Road Surface

GERMAN highway officials are building a number of sections of highway consisting of cast-iron grids, the openings of which are filled with asphalt mastic or other surfacing material. The grids are 3.28 ft. wide and as long as the travel surface is wide. These grids are laid directly on the shaped subgrade. It is asserted that the hexagonal shape of the cells and the use of cast iron instead of steel adds to the rigidity, resists corrosion longer and has less temperature movement to disturb the filling. The grids cost less than steel.



**Cast-iron grid laid on subgrade and filled with road-surfacing material.**

## Treating Timber After Framing

TREATMENT of timber for trestles and bridges after framing is fast becoming standard practice. Engineers send their plans to the treatment works, which sets up machines for the framing of timbers. This can be done at less cost than in the field. The Santa Fe Railway recently built a 980-ft. timber bridge containing 64 frame bents, framed and bored at the plant before treatment. The bents were assembled complete and shipped ready for erection. The foundation rested on rock only a few feet below the streambed.

In both field-framed and shop-framed timber work there are usually additional holes to be bored at swaybraces, for instance, as it is impossible to determine the depth to which piles will be driven. To treat field-bored holes under pressure, *Wood Preserving News* describes a device consisting of a small hand pump that screws into the end of the bored hole and a plug that screws into the opposite end of the hole. The device is arranged so that holes bored in piling for swaybrace bolts can be treated without removing the swaybrace. By this means the preservative penetrates the wood, giving a more permanent protection than can be obtained by painting or swabbing with hot creosote.

## *Job and Office Notes*

WHEN doing survey work in traffic or other exposed locations, both instrument and man may to a certain extent be protected by painting the tripod legs with 1-ft.-wide bands of bright enamel, alternating red and yellow. Many motor-vehicle operators apparently drive with their eyes shut, but this precaution reduces the hazard somewhat.
—ARNOLD V. STAUBACH, NEW YORK, N. Y.

❖

WHEN LINING in stakes either for grade or line, or when replacing stakes, a pocket telescope such as costs about $2 is often as accurate as setting up a transit, and more handy. Make a socket in one end of the stake by cutting out a half circle to fit the pocket telescope and place a strap over it to hold it in place. Draw a line down the side of the stake from the center of the telescope and cut the stake off at a length of 1 ft. For leveling, a stake should be set up behind the stake at the starting point with a line drawn down it for center line and with the top 1 ft. above grade. By using another stake 1 ft. long as intermediate point for grade, and a pencil or nail for line, line and grade point can be set quite accurately. Coloring the top ½ in. or so of the farthest stake helps to make it visible.—A. O. BOSSHARD, OLLIE, IOWA.

❖

AT AN asphalt plant in Holland the mixing time for the asphalt, sand, stone and filler is automatically recorded, facilitating control of the operations. An electrical recording device is used, with the current controlled by a tilting mercury switch attached to the mixer's dump control and another similar switch on the gate of the asphalt bucket.
—A. DELEEUW, AMSTERDAM, HOLLAND.

❖

WHEN a locomotive crane is left on the job temporarily, half a water barrel placed over the smokestack will prevent rain from entering the stack or boiler.

❖

MORE CARE in selecting reference points will save considerable time when attempting to reestablish old survey lines. When a point has been referenced to three fence posts all on the same side of the line, when one or more of the reference points has been destroyed, it is often impossible to tell which of the given distances to apply to remaining points. If one reference point is placed on a post to the right of the line, one to the left and the other on a telephone pole, it will be easier to tell which of the distances to apply to the remaining point if one should be missing. Another way is to choose a post on the left of the line at right angles to the point to be referenced and the ones on the right, placed so as to be considerably ahead and behind the point, respectively, and to record their relative positions on the plans. Also when trees are used for references, the diameter or the species should be varied so as to make identification easier.
—P. H. PECK, MISSOURI STATE HIGHWAY DEPARTMENT.

❖

WHILE constructing a highway bridge, workmen discovered two boiling springs under the footing forms. An attempt was made to smother the springs with concrete, but the water came up through it. Enough concrete was then shoveled out from over the springs to allow working room. Two pieces of 1-in. boards were nailed together as an inverted trough and placed over the springs to form the roof of a conduit leading the water outside the foundation forms. A piece of sheet metal was then placed over the springs and the rough trough. A sump was formed outside the foundation to which the spring flow could be led, and a gas-driven pump removed the water that collected. The concrete was then placed in the forms over the sheet metal. The pump was kept running until the concrete was hard enough to prevent the water from damaging it. —R. WILSON, FLINT, MICH.

❖

THE PROBLEM of keeping streets open during heavy snowfalls was solved for the Spokane United Railways last winter by roadmaster M. B. Sullivan, who designed a combined motor-truck plow and sander, using a light utility truck. The plow, operated by a man sitting beside the driver, is mounted on a steel frame projecting from the front of the truck, with chains for raising and lowering and a steering device to guide the angle of the plow. In the rear a fertilizer spreader was mounted on the truck body, and gears were installed so that the spreader could be operated by a chain from a sprocket on one of the rear wheels.

❖

TO REMOVE greasy or dirty finger marks from drawings, place sheets of blotting paper over and under the stained portion. Lay powdered magnesia on the stain and under it, then press the blotting paper with a hot iron. When the powder is shaken off, the stain will be gone.

TO BLACKEN brass for templet work, it should first be thoroughly cleaned and then heated slowly over a charcoal fire. Care should be taken not to allow the brass to touch the charcoal or to allow any sparks from the charcoal to come in contact with it, as this will cause red spots. As soon as the brass has a slightly red hue, dip it into nitric acid and reheat it until it is just short of being red. Rub it strongly with a stiff-bristle brush and clean with a greasy cloth. This gives a dead black finish, permanent enough for any layout work.—CHARLES R. WHITEHOUSE, BOSTON, MASS.

# Road Administration Revamped in Indiana

## Special session of state legislature redistributes motor-vehicle road funds and makes county smallest administrative unit

By Ben H. Petty
*Professor of Highway Engineering, Purdue University, Lafayette, Ind.*

THE SPECIAL forty-day legislative session in Indiana from July 7 to Aug. 15 resulted in some drastic rearrangements in the highway set-up of the state, which are destined to produce far-reaching effects. Some of the road measures enacted have been advocated in certain quarters for years and will, without question, greatly improve road procedure. Others are rather pioneering ventures, and only time will reveal their degree of desirability.

### Mileage and expenditures

For the past several years, three separate and independent road organizations have existed in Indiana—namely, state, county and township systems. There are approximately 73,000 miles of roads in the state, divided, prior to the special legislative session, about as follows:

| | |
|---|---|
| State system | 8,000 miles |
| County system | 42,000 miles |
| Township system | 23,000 miles |

The state roads are entirely controlled by the state highway commission, including both construction and maintenance. For the year ending Sept. 30, 1931, the funds for state roads were derived as follows (to nearest hundred):

| | |
|---|---|
| Motor vehicle license fees | $ 5,974,900 |
| Gasoline tax | 13,421,600 |
| Federal aid | 5,153,400 |
| Reimbursements and miscellaneous | 1,121,900 |
| Total | $25,671,800 |

It will be noted that of this total the motorists paid 75 per cent. Indiana operates under the pay-as-you-go policy, since state bond issues are prohibited by the constitution. The state gasoline tax is 4c. per gallon, being distributed, prior to the special enactments, 75 per cent to state roads, 18¾ per cent to county roads, and 6¼ per cent to city and town streets. The license fees are low, ranking the state about 37th from the top of the list.

County road matters are under the general control of a board of three county commissioners elected on overlapping terms of three years. Construction is under the supervision of a county surveyor elected for a term of only two years. County-unit road construction is financed by bond issues against the county as a whole. Maintenance of county roads is carried on by a county highway superintendent appointed for a four-year term by the commissioners. Maintenance funds were secured by a property tax limited to a maximum of 1c. per $100 of taxables for each ten miles of county roads, in addition to the county's share of gasoline tax. For 1930, county road expenditures were as follows:

| | |
|---|---|
| Construction | $ 3,809,900 |
| Maintenance | 9,112,200 |
| Total | $12,922,100 |

Maintenance costs averaged $213 per mile. However, this includes some construction handled by the maintenance department.

All unimproved roads in the township system were maintained by a township trustee elected for a term of four years. Maintenance funds resulted from a property tax limited to a maximum of 30c. per $100 of taxable rural property. Since there are 1,016 townships in the state with an average of only 22+ miles per township, it is quite evident that uniform, economical maintenance was out of the question. Township roads, on being improved to county standards, immediately became county roads. Construction was under the Three-Mile Road Law, supervised by the county surveyor and financed by bond issues against the entire township. During the year of 1930, township road expenditures were as follows:

| | |
|---|---|
| Construction | $ 7,257,800 |
| *Maintenance | 2,500,000 |
| Total | $ 9,757,800 |

*Estimate based on expenditures for previous years.

Maintenance averaged about $100 per mile.

### New allocation

The prime motive of the recent special session of the legislature was reduction of taxation on property. The elimination of local road maintenance tax provided one avenue of marked reduction in line with this motive. For instance, farmers in a certain township might be paying a property tax as high as 30c. for county road maintenance in addition to a 30c. tax for township road maintenance. The new legislation entirely eliminates both these taxes. This was accomplished by turning over all township roads to the counties, effective Sept. 10, and abolishing all property tax for road maintenance.

In lieu of these property taxes, the counties were allotted 40 per cent of the state gasoline tax and 40 per cent of the motor-vehicle license fees, payable in four installments "to be used by the board of commissioners in any county in the construction, maintenance or repair of any county highways or bridges." This will give the counties about $11,500,000 for all local roads in 1933. Of this 40 per cent of gasoline tax and 40 per cent of license fees allocated to the 92 counties, one-eighth is distributed on the basis of county population and seven-eighths on the basis of county road mileage. One exception is provided in the case of Marion County (containing Indianapolis, which is the only first-class city in the state), wherein half the allotment goes to the county and half to Indianapolis.

The cities and towns under the new legislation will receive 10 per cent of the state gasoline tax and motor-vehicle license fees as compared to the previous 6¼ per cent of the gasoline tax only. These funds are allocated on a basis of population.

This greatly increased diversion of state highway funds to local roads and streets resulted in more controversy than any other phase of the new road legislation. It takes about $7,500,000 from the state highway commission, and will result in a reduction of construction from over 500 miles in 1932 to probably less than 200 miles in 1933, thus cutting construction personnel from 30 to 50 per cent. These diversion results are summarized in the accompanying table.

REVISED ALLOTMENT OF ROAD FUNDS IN INDIANA

| Items | Unit | Per Cent Before | Per Cent After |
|---|---|---|---|
| Federal aid | State | 100 | 100 |
| Gasoline Tax | State | 75 | 50 |
| " " | County | 18¾ | 40 |
| " " | Township | none | none |
| " " | Cities & Towns | 6¼ | 10 |
| M. V. license fees | State | 100 | 50 |
| " " " | County | none | 40 |
| " " " | Township | none | (no township roads now) |
| " " " | Cities & Towns | none | 10 |

In using the word "diversion," the writer refers, of course, to diversion of funds from state roads to local roads and streets. No gasoline tax or motor-vehicle license fees in Indiana are diverted to uses foreign to construction and maintenance of roads, streets and bridges.

### Other changes

Other legislation affecting road and street affairs enacted by the special session includes:

1. The state highway commission shall mark and maintain streets used as state routes through cities or towns having a population under 3,500 and may improve same if unimproved.

2. The state highway commission

may improve unimproved streets used as state routes through cities or towns having a population above 3,500.

3. It shall be unlawful for the board of commissioners of any county to issue any bonds or other evidences of indebtedness, payable by taxation, for the construction or improvement of any county unit, gravel or macadamized road prior to Sept. 1, 1937.

Thus the legislative action has eliminated the township road unit, eliminated property tax for all local road maintenance, placed the burden of local road maintenance on motorists, reduced the state highway construction program at least 60 per cent, increased cities' and towns' shares of motor funds about 60 per cent, and discontinued local road construction by bond issue for five years.

# *Letters to the Editor*

## Dams on the San Andreas Fault

Sir—In an article on three dams on the San Andreas fault in your issue of Aug. 25 you describe the condition of the Upper Crystal Springs dam immediately after the earthquake of 1906. You state that this earth dam, which crosses the fault, suffered no serious damage and required no reconstruction except the brick-lined outlet conduit which passes through the northeast abutment.

The writer visited this dam as well as the other dams described in your article three weeks after the earthquake. The visit was made in company with a party of engineers under the guidance of the late Herrman Schussler, then chief engineer of the Spring Valley Water Co.

As the writer recalls the condition of the dam, there were several shear cracks along the plane of fault, and in addition thereto there were numerous longitudinal cracks extending either way from the fault cracks, both through the top and the slopes of the dam.

The dam at that time served the sole purpose of a highway across one arm of the reservoir, the outlet conduit being open and the water standing at the same elevation on both sides of the dam.

Among the visiting engineers a discussion arose as to what would have been the fate of the dam, had it served its original purpose at the time of the quake, namely holding water on one side only. There was difference of opinion, Mr. Schussler and others holding that the dam would have been safe and would have shown no leakage. The argument was that the clay core was of such plastic nature that it was folded and bent by the quake but had not sheared. To this argument many of the visitors, including myself, objected because a tightly rammed clay core could not possibly be conceived to resist shear during a sudden cross movement amounting to 8-ft. A shear crack across the dam would have been certain to cause leakage and would have caused progressive erosion first of the earth supporting material and next of the clay core itself. Considering the toughness of the core erosion would probably have been slow, and prompt emergency measures might have saved the structure, but this is uncertain.

The heading of your article to the effect that the dams resisted the earthquake presents in the opinion of the writer too optimistic a picture, which he deems it desirable to correct. The only dam material that would have prevented an actual crack along the plane of movement is clean gravel, which would have subsided back into place, re-establishing contact. Such material placed in sufficient quantity downstream from the core, well drained and reaching above the water line, would to some extent insure against a disaster in similar cases.

D. C. Henny,
Consulting Engineer.

Portland, Ore.,
Sept. 8, 1932.

## Causes of Depression

Sir—In regard to the letter of J. V. Nimmo (*ENR.*, Aug. 25, 1932, p. 233) and your editorial comment thereon, it seems to me that a more definite answer can be given. A social phenomenon as far-reaching as our current depression must of course be the result of the interaction of a number of causes, and economists may still debate as to the relative weight which should be given to each. When carefully considered, however, most will be found to be contributory or secondary, and only a few primary.

Among those qualified to judge I believe that Prof. John Dewey is generally regarded as one of our wisest men, and he has recently stated what he considers to be the two major causes, as follows:

> "Billions were put into pieces of paper ironically called securities, floated through control of all the machinery, legal and extra-legal, of corporations, mergers, issuing of stocks. Billions were poured into stock speculation which inflated things that were ironically called values into a bursting balloon. Billions were loaned, almost forced, upon European and South American countries, so that bankers might have commissions on the tokens of credit they passed on to their customers in a criminally irresponsible fashion. These loans were then used to inflate business in foreign countries. Their deflation reacted to start our own industrial and financial crisis. Let experts quarrel, if they will, about the details of the causation of our economic collapse. But in the large, one cause is so stamped upon it that anyone who wishes may read. Credit which is absolutely the sole indispensable vital agent of modern economic life has been made a football of private gain by private individuals. This has been made possible because society has not attempted control of money and credit.
>
> "The other fact at which I ask you to look is the dependence of the crisis upon the enormous inequity in the distribution of the national income. When a small part of the population, a very small part, has an income far beyond any possible extension of consumption of goods and services, it must invest the surplus in plants which increase production still further, thus creating more goods to be consumed—provided there exists purchasing power to buy them as a preliminary of consumption. But meanwhile the mass of the population is not receiving, because of private control of the sources of production and exchange, the means which will enable them to buy what the plants are producing. Finally, some crisis, in connection with credit, forces this disparity to the foreground. Goods are not sold; factories shut down; men and women are thrown out of work and can buy still less; more factories close; shops close because they are losing money; banks fail, and so on, in the vicious circle in which we are now enclosed. Society has used no means for control of the delicate mechanism of production and distribution in relation to consumption and purchasing power. It has not in this country the constitutional means which it can use to effect control. Thus our crisis is not an accident, nor our unemployment a visitation from heaven or hell—except the hell of our own making."

The quotation is from an address entitled "Democracy Joins the Unemployed," a copy of which may be obtained by addressing the League for Independent Political Action, 112 East 19th St., New York City.

Ralph W. Powell.

Iowa City, Iowa,
Sept. 1, 1932.

# Engineering News-Record

EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, W. G. Bowman, F. W. Herring, C. S. Hill, H. W. Richardson, W. W. De Berard, N. A. Bowers, J. I. Ballard.

Editorial and Publishing Offices at 330 West 42d St., New York; 520 North Michigan Ave. Chicago; 883 Mission St., San Francisco; Aldwych House, London, England.

Subscription price $5 per year in the United States; foreign rates on application.

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SEPTEMBER 29, 1932 Volume 109 Number 13

## *In Line of Duty*

STRICKEN DOWN in the middle of his work, by the force of the driving energy he put into it, John R. Slattery met his death in line of duty. During seven years, first in supervising the construction of the Eighth Avenue Subway and then in organizing it for operation, he had driven himself at almost superhuman speed, and at the very moment that the subway was opened to the public he paid the penalty in a collapse that proved fatal. Others before him have made the same sacrifice to engineering duty and responsibility, nearest and warmest in memory Clifford Holland, tunnel builder, Frank Wight, editor, and William Starrett, builder of skyscrapers. Engineering drives its best men hard—too hard, we think. But their contribution to mankind's advancement endures. The subway which Colonel Slattery completed and organized so brilliantly now serves millions to their greater effectiveness, and the strengthened spirit of performance which he gave to the group of able men engaged in New York's transportation planning will long remain alive, to the benefit of all.

## *Money and Construction*

ALL construction interests have reason to follow the rising level of bond prices, for it indicates that money is seeking employment. Other evidence points in the same direction. Municipal bonds are unusually scarce in the investment market; the greatly reduced issues of the present year have been fully taken up by those who seek assured and profitable employment for their funds. Perhaps for this reason one of the leading banks in its current bulletin suggests that curtailment of public construction has been pushed too far, and that economy in government lies in reducing operating costs rather than in curtailing capital expenditure. Bank comment usually tends to reflect the money viewpoint exclusively, but the present suggestion implies that banks are coming to see the vital importance of public construction for the improvement of community services and amenities, and to recognize its intimate relation to employment, business activity and property value. If this view gains ground, construction will soon win back its rightful place in the world of action.

## *New Factories for Old*

NOW that money is again taking heart, industry and business also begin to show new life. The last few weeks have brought signs of progress at many separate points. The progress might be faster but for timidity—a quality which everyone was forced to acquire in two years of hard experience and which by now is rooted in habit. However proper retrenchment and caution may have been a few months ago, they are out of place today; initiative and action are wanted in their stead. Unfortunately the individual can move forward only faster than the general current of business sentiment. It will, therefore, be of high value if a general quickening of spirit is brought about by the recently initiated movement to rebuild industry's plant and equipment. Everyone needs new courage, and despite the present low costs it takes courage to erect a new factory or equip an old one in these days. But such courage, supported by the employment and business that the work itself will produce, can aid powerfully in returning us to normal. The wage-earner's purchasing power is basic, of course, for without it industry has no one to serve. Construction, by providing this basic employment, prepares the ground for aggressive modernization of industrial facilities, which in turn means revival of business.

## *For a New Spirit*

IF BUSINESS at large needs a general quickening of spirit so that enterprise and courage may once more flourish, each single industry has a like need within its own circle. Not least of these is the construction industry. Construction still retains its determination and its clearness of vision, but the life-giving attributes of enthusiasm and helpful outlook have largely departed. To bring them back is the great mission of the construction congress which will be held in Detroit next January. A score of separate units of the industry's organization will come together there—a meeting quite without precedent. The opportunity offered by this unique occasion merits purposeful preparatory effort. Each of the participating units can bring to the congress a statement of its problems, plans and suggestions. Full interchange of thought on this basis can lead to a cooperative harmony of effort and to an intimacy of understanding that will do much to build the scattered construction groups into a united industry.

## *Action on a Large Scale*

ENTERPRISE that commands respect is shown in the planning of the four huge housing projects approved by the New York State Housing Commission last week and soon, we trust, to be put under construction. They mean employment for a great army of idle men. They mean also acceleration of business, improvement of living conditions for thousands of families, reclamation of blighted city areas and a check to city disintegration. These are public benefits of real importance. The men back of the projects, in time, will reap the advantage of phenomenally low construction costs, in addition to the satisfaction of contributing to industrial recovery and to civic improvement. Their initiative is a shining example, an incentive to builders and public-spirited citizens in the many states that still lack modern regulating housing legislation. But their enterprise would not have been possible without long preparation. The foresight and idealism of those who worked for housing legislation years ago are at the root of the large-scale action now set in motion.

## *Low-Cost Housing*

OPPOSITION on the part of real estate and investment interests to low-cost housing development has become increasingly articulate since the passage of the emergency relief and construction act, which offers

financial aid to such enterprises. The basis of this opposition is the belief that subsidized housing would depress existing property values and rents. Whether this belief be justified or not, the fact remains that low-cost housing is a recognized social need, that its construction offers a fertile field for unemployment relief and business stimulation, and that if undertaken on a large scale it would rescue many blighted city areas from a state of economic collapse. Are these advantages overshadowed by the single disadvantage? In the present unemployment and business emergency the answer is clearly in the negative; the long-time policy can be considered later, when the need arises. No doubt, private enterprise in the field of dwellings is entitled to reasonable safeguards against subsidized housing, but private effort has made a significant failure in the very field to which the new efforts in housing are directed, namely provision for the low-income masses. To call such efforts a menace is therefore neither fair nor sensible. If private initiative cannot serve this field, recourse to public aid is in the general interest.

### *Paying to Learn*

IN THE specifications issued by New York for a section of grouted road to be built at Newburgh this fall there is reflected a praiseworthy attempt to learn what a new method can do to promote economy and efficiency in roadbuilding. Essentially the method is old, for the Hassam pavements built a couple of decades ago are close prototypes; but the conditions of present-day roadbuilding and road service nevertheless make it a new method, whose details require to be worked out by careful planning and studied practice. The trial sections which various states are now engaged in building have to answer many questions of slab design and construction procedure before the best road structure is obtained at lowest cost. Close observation of the behavior and life of the finished road in relation to traffic load and density, also, must be awaited before the place of this pavement type in our entire road system can be determined. It is therefore a worth-while undertaking to build trial sections now, under careful planning and control. The field of moderate-service roads is a large one, and new methods will aid in serving it.

### *Westward Ho!*

A DREAM of years is to be realized; Denver is to get a direct outlet to the West. Years of planning and of bitter disappointment through the collapse of plans or their failure to develop fully ended a few days ago when the Reconstruction Finance Corporation agreed to provide money for construction of the Dotsero cutoff, joining the Moffat line west of the divide with the main line of the Denver & Rio Grande Western Railway. True, the cutoff will not provide the direct line to Salt Lake that was hoped for when the Moffat line was first projected, but it will nevertheless make it no longer necessary to go many miles south or north from Denver before turning west. Denver will hereafter lie along a through railway line from East to West through the Rocky Mountains. Heavy grades on the Denver & Salt Lake Railway up to the Moffat tunnel do not make it attractive as a through route, but that is of little moment now. What matters to the people of the Denver region is that they have a direct outlet to the West. This they will get through construction of the Dotsero cutoff.

## Railway Problems to the Fore

EVENTS of the past week emphasize the nation-wide significance of the present plight of the railroads and the need for a solution of their problems as a major element of business recovery. Consummation of the four-system consolidation plan for the Eastern trunk railroads under the pressure of failing incomes, the reported organization of a committee representative of savings banks, trust funds and other holders of railroad bonds to study means of protecting their interests, and publication of proposals for improving railroad conditions to be submitted to the full membership of the U. S. Chamber of Commerce, all indicate how urgent is the need for improved conditions in that great industry. And, across the border, the report of a special commission appointed to study and recommend means for improving the financial condition of Canadian railroads shows clearly that the problems are not peculiar to the railroads of this country. Nor are the problems entirely an outgrowth of the current business depression; the source of many of them lies deeper and cannot be expected to disappear when general business recovers.

For this as well as for other reasons the conclusion is inescapable that Congress when it meets in December will have to give serious consideration to these problems if the principal element of our transportation system is not to be completely disorganized. The imminence of difficult wage discussions and the approach of new demands for restrictive regulation of highway traffic in the coming sessions of state legislatures—such conditions increasingly emphasize the seriousness of the predicament in which the railroad operators and investors find themselves. What part of it is due to the current depression, what part to the inefficiency or lack of vision of railroad managers and what to conditions beyond their control no one knows. It must, however, be determined and the facts faced fearlessly if a satisfactory solution is to be found.

A tangled mass of difficult questions is involved. They include matters of planning, operation and finance.

How much of our present system of railroad regulation is obsolete and unnecessary? Is it still necessary to maintain a high degree of competition between railroad systems, or has the advent of truck and bus supplied a more natural way of keeping transportation costs at a reasonable level? Is railroad regulation unduly repressive and does highway construction subsidize motor transport to the disadvantage of rail transportation? Should railroads continue to pay a major part of the cost of grade separations? Is there justification for the government continuing to spend hundreds of millions of dollars annually on inland waterways without requiring the traffic moving over them to pay part of the cost of building and maintaining them? Has so radical a change occurred in our entire transportation system as to require the abandonment of many rail lines and a complete reconstruction of our railroad terminal system? If so, must the federal government tide the railroads over the period of financial readjustment that will be necessary?

These and kindred questions cannot long go unanswered. Attempts to answer some of them have been undertaken, but as yet no one has approached the entire railroad problem with the comprehensive view and detailed study that are needed. Congress must initiate a study on a much broader scale than has yet been attempted.

# NEWS OF THE WEEK

## Four-System Plan of Rail Grouping in East Approved

THE PLAN of the Interstate Commerce Commission for consolidating the railroads of the eastern part of the country, exclusive of New England, into four systems built up around the New York Central, the Pennsylvania, the Baltimore & Ohio and the Chesapeake & Ohio-Nickel Plate systems, was approved by the heads of those four systems at a meeting held in New York on Sept. 23. Following the meeting the executives announced that they had agreed to compose all the differences existing between them as to the proposed systems, and as a result it is expected that negotiations for the consummation of the plan will hereafter be carried forward as rapidly as possible. The commission's plan was announced in July. With one or two important exceptions, it follows closely a consolidation plan presented to President Hoover by executives of the eastern trunk railway system about two years ago.

### Four systems outlined

Under the approved plan the New York Central gets the Lackawanna except its Oswego branch, which goes to the C. & O.-Nickel Plate system to give it access to Lake Ontario; the Virginian Railway; the Rutland, except its Ogdensburg and Lake Champlain divisions; a fourth interest in the Lehigh and New England, the Montour, and the Pittsburgh and West Virginia Railway east of the Gould tunnel. This gives the system a mileage of 7,900.

Pennsylvania obtains the Wabash; Detroit, Toledo & Ironton; one-half interest in the Raritan River R.R.; and one-fourth interest in the Lehigh & New England and other roads noted above. The mileage of this system will be 13,000.

The Baltimore & Ohio gets the Reading; Central Railroad of New Jersey; Western Maryland; Ann Arbor; Detroit & Toledo Shore Line; Lehigh & Hudson; Alton; Buffalo, Rochester and Pittsburgh; Buffalo & Susquehanna; one-half interest in the Raritan River R.R. and one-quarter interest in the Lehigh & New England and other roads previously noted. The mileage will be 8,800.

The Chesapeake & Ohio-Nickel Plate, in addition to the Oswego branch of the Lackawanna, previously noted, gets the Lehigh Valley, the Bessemer & Lake Erie; Wheeling and Lake Erie; Pittsburgh & West Virginia west of the Gould tunnel; and one-fourth interest in the line east of the tunnel; Pittsburgh, Shawmut & Northern; Chicago and Eastern Illinois; Erie; and one-fourth interest in the Lehigh & New England. The mileage of this system will be 8,100.

Many of the railroads assigned to the main trunk lines already are controlled by them.

Disposition of the New England lines, except the Boston & Albany, remains to be determined in the future.

## Golden Gate Bridge Work Put up for New Bids

With $6,000,000 worth of bonds sold and all legal questions settled, the directors of the Golden Gate Bridge and Highway District have called for new bids on most of the work because original contracts lapsed during the months of litigation. New bids will be called for all items except the superstructure steel; the previous contract with McClintic-Marshall Co. of $10,500,000 for this item was allowed to remain in effect. New bids on the other items were called for Oct. 14.

Principal items to be rebid and the low figure submitted when the original bids were received in June, 1931, include:

| | |
|---|---|
| Foundations | $2,260,000 |
| Steel cables | 6,256,000 |
| Anchorages and approach piers | 1,645,000 |
| Approach superstructure | 996,000 |
| San Francisco approach road | 966,000 |
| Marin approach road | 67,000 |
| Paving | 345,000 |
| Lighting | 133,000 |

After months consumed in settling legal controversies this important project should be under active construction within the next 60 days.

## Employment of Engineers Gains in Philadelphia District

A noticeable increase in requests for engineering personnel and in the number of men returned to work through its efforts is reported by the Philadelphia Technical Service Committee. Up to the 23d of September the committee had placed 150 men, 40 of whom were placed on work with municipal and civic organizations financed from a fund subscribed by individual engineers and by the societies sponsoring the work of the Technical Service Committee.

The committee reports that a movement is now on foot to raise $50,000 to extend this type of service until 200 engineers with dependent families can be cared for.

## Extensive Sewer Work Planned To Extend Dallas Storm System

Contractors for the construction of storm sewers in Dallas, Texas, in addition to those already let are expected to bring the total value of work put under contract within the next few months close to $1,000,000. Plans for the sewer on the west fork of Peak's Branch, estimated to cost $300,000, are expected to be ready about Nov. 1. Contracts for the first unit on the west fork to cost about $98,000 have been let and bids on the second section, estimated to cost $210,000 were opened on Sept. 28. Plans for the fourth and fifth units are expected to be ready early next year.

Part of the work on the east fork is under contract and plans for the remainder are expected to be ready for bidding about Jan. 1.

## New Orleans Bridge Gets Second Loan Granted by R. F. C.

FINANCING the proposed bridge of the New Orleans Public Belt R.R. was approved by the Reconstruction Finance Corporation on Sept. 27. The corporation has agreed to bid for bonds of the state of Louisiana and to purchase bonds of the Public Belt Railway Commission in amount sufficient to provide for the construction of the bridge, estimated to cost $13,000,000. Interest will be at the rate of 5 per cent.

The proposed bridge is to be built about 9 miles above New Orleans. It will have a length of 3,525 ft. and will require long approaches as it is to have an underclearance of 135 ft. over the main channel of the Mississippi River. The main river piers will have to be carried at least 170 ft. below low water to reach firm foundation. The plans have been approved by the engineers of the R.F.C.

The bridge is to carry a double-track railroad line and two 18-ft. roadways. No tolls will be charged for use of the highway. Funds for interest and to amortize the state bonds will come from gasoline tax. Rental will be charged the railroads using the bridge and will be used to pay off the commission's bonds.

### Work to start soon

Plans for the bridge are complete and bids on the work have been obtained. About 60,000 tons of structural steel and reinforcing steel will be required, 200,000 cu.yd. of masonry, 4,000,000 ft. b.m. of timber and 1,200,000 lin.ft. of piling. Construction will require 25 months and will employ about 1,000 men.

The directors of the R.F.C. also approved a loan of $105,000 for additions to the municipal power plant at Madison, S. D.

### Aqueduct loan opposed

A taxpayers' suit seeking to enjoin the Reconstruction Finance Corporation from carrying out its announced intention of extending $40,000,000 aid to the Metropolitan Water District of Southern California has been filed in the District of Columbia supreme court on behalf of three citizens of Los Angeles county. The complainants contend that the proposed $220,000,000 aqueduct to the Colorado River is not self-liquidating within the meaning of the relief act and therefore is not legally eligible for assistance from the R.F.C. They also assert that the proposed aqueduct is not necessary at this time and that consummation of the project will injure present property owners in the water district through increased water rates and taxes.

### More applications received

The mayor and town council of Fincastle, Va., are planning to apply for a loan from the R.F.C. for construction of their water and sewerage systems.

Plans are being considered for the construction of waterworks and a municipal light plant at Winchester, Va. The pro-

posed construction will involve an expenditure of $600,000. It is planned to apply to the R.F.C. for a loan.

Farrell, Pa., is planning to engage a geologist to determine whether artesian wells can be drilled to supply the city with water. If the proposed project proves feasible, the city may apply to the R.F.C. for a loan of $400,000 for the waterworks system.

Plans are being discussed in Youngstown, Ohio, for applying to the R.F.C. for a $100,000 loan to finance the building of storm sewers.

The city council of Clifton Forge, Va., has conferred with James Anderson, a member of the engineering board of the Governor's R.F.C. advisory council, to discuss proposed self-liquidating projects for the city. Extension of the city water system or sewer system is favored.

A public meeting in New Castle, Va., gave lengthy consideration to a proposed application to the R.F.C. for a loan for construction of a modern sewage plant and sewerage system.

### Many bridges planned

A detailed formal report has been filed with the R.F.C. accompanying the application for a loan of $10,000,000 to construct a toll bridge across Chesapeake Bay. The proposed bridge was to run from a point 8 miles south of Baltimore to the eastern shore of the bay. The length of the bridge is to be 8¾ miles. It is being projected by the Chesapeake Bay Co. Opposition to the loan application has been made by former Governor Harrington who is president of the corporation operating ferries across the bay. He states that a bridge such as the one proposed would deprive the boat lines of a substantial part of their business.

A 5-mile toll bridge across Appalachicola Bay, Florida, to cost about $2,500,000, will be the subject of a loan application to be made to the R.F.C. The Standish Engineering Co., Chicago, Ill., formerly had a franchise and a contract to construct this bridge. The work was started but later abandoned because of difficulties in financing. A county bond issue was recently voted to complete the construction. The bonds are to be secured by a first mortgage on the bridge. It is planned to turn the bonds over to the Florida State Road Department which is applying to the R.F.C. for a loan to carry out the project.

A loan application is contemplated for a bridge across St. John's River at Jacksonville, Fla., to cost about $1,500,000. The bridge is to be built by the commissioners of Duval County.

A loan of $39,400,000 has been asked of the R.F.C. to construct a rapid transit tunnel in New York City connecting Staten Island with Brooklyn. The line would connect with the new 8th Ave. subway. The city has not acted on the proposal.

Bessemer, Mich., has recently voted favorably on a proposal to borrow $135,000 from the R.F.C. for construction of a municipal electric light plant.

### Early application renewed

Wilmette, Ill., has perfected its application for obtaining $600,000 for the construction of a 6 m.g.d. filtration plant, pumping station and intake. Its officials were in Washington Sept. 29 for a hearing. Work can be initiated within 60 days and an average of 90 men working 30 hours per week will be required during the full 18 month period of construction.

Eau Claire, Wis., has made preliminary application for $500,000 to develop a new well water supply for which Pearse, Greeley and Hansen, are engineers. Investigations for sources and location of wells free from iron are nearly complete.

F. C. Dugan, director, Bureau of Sanitary Engineering, Kentucky State Board of Health, states that the following cities have made application for funds for water or sewer projects: Columbia, Greensburg, Hopkinsville, Owingsville and Bowling Green. In Kentucky there is $336,500 worth of sewage and water projects planned but prevented from going ahead by financial difficulties.

Moline, Ill., is making preliminary application for $125,000 with which to construct a public natatorium. It is proposed to form a private company made up of local business men without thought of profit which will issue bonds to be liquidated by service charges. When paid for the natatorium will be turned over to the city free of cost. John F. Huey, mayor, is handling the matter. Special legislation in Illinois will be sought at the January session permitting cities to make pools self-liquidating.

Several swimming pools in Iowa can be financed on a self-liquidating basis and will go ahead if the test case of Pella can be successfully worked out, says Howard R. Green, consulting engineer, Cedar Rapids. Experience in Iowa with other pools indicates that the pool could be paid for out of 25 cent admissions within ten years. Work could go ahead within two weeks.

### Irrigation Loans Possible

An interpretation of the law governing the Reconstruction Finance Corporation, as made by its legal department, makes it possible for irrigation districts in the Lower Rio Grande Valley to obtain loans for extensive improvements, according to W. B. Lewis of Harlingen, attorney for six of these districts, which have applications pending for loans aggregating approximately $15,000,000. He said that a legal ruling has been given that money paid by property owners of these districts is a benefit assessment, rather than a tax, and that this interpretation permits the loans. The largest of these loan applications is that of Willacy County Irrigation District No. 1, for $5,000,000, to be secured by $7,000,000 of its bonds. The expansion program of these six districts, and of a number of others of the 38 irrigation districts in the Valley, which has been held up for nearly two years, due to failure to sell their bonds, will be resumed as soon as the loans from the Reconstruction Finance Corporation are obtained, it was stated.

*Curtiss-Wright Photo*

**MAIN ROCKEFELLER CENTER BUILDING TOPPED OUT**

On Monday, Sept. 26, the steelwork of the 69-story RCA Building in the Rockefeller Center development, New York City, was topped out. First foundation grillages were set Feb. 8 and the first structural steel arrived on the job March 7. Said to contain a larger rentable area than the Empire State Building and requiring 58,500 tons of steel as compared with 53,000 tons in the latter structure, the RCA Building is in the first rank of the super-skyscrapers. It covers a plot 200 ft. wide by 535 ft. long. The tower is about 100x325 in plan. Setbacks are small and occur in general only where elevator banks are stopped off. A 16-story wing on the west front is connected to the tower by a 12-story windowless section devoted to broadcasting studios. The view shows that all of the structures on the western half of the three-block site of Rockefeller Center are well along toward completion. At the right of the 69-story RCA Building is the 31-story RKO Building and the International Music Hall. Behind the RCA Building may be seen a corner of the Sound Theater at 6th Ave. and 48th St.

Post & McCord erected the steel and Hegeman-Harris Co., Inc., is the general contractor for the RCA Building. Todd, Robertson & Todd, and Todd & Brown are the builders and managers of Rockefeller Center. The architects are Reinhard & Hofmeister, Corbett, Harrison & MacMurray, and Hood & Fouilhoux.

# Good Progress Made on Madden Dam in the Canal Zone

WORK on Madden Dam in the Canal Zone has progressed to the point where the placing of concrete in the main dam was begun on Sept. 1 and is now going ahead at the rate of 600 cu.yd. per shift. This rate will be increased as soon as more of the foundation area becomes available. About 80,000 cu.yd. of rock and 130,000 cu.yd. of earth have been removed from the area of the main dam. Ten of the smaller earth dams closing off saddles around the reservoir have been completed.

The steel sheet piling for the 1932 cofferdam enclosure has been completely driven and unwatering was begun on Sept. 5. Construction within this cofferdam will require full speed operation during the next few months to allow diversion of the Chagres River to occur in January.

**South abutment of Madden Dam in the Canal Zone showing progress made up to the end of August when the placing of concrete was begun. In the foreground is the completed cofferdam closing off part of the river channel.**

The rainy season which lasts from May to December, has been the cause of difficulties encountered in the excavating program. It has not, however, caused the contractor to curtail such activity.

The Madden reservoir is being built to supplement the water supply of the Panama Canal. A description of it was given in *ENR*, July 30, 1931, p. 162. A contract for the construction of the dam was let to W. E. Callahan Construction Co. and Peterson, Shirley & Gunther about a year ago. Construction of the dam is under the direction of the Governor of the Canal Zone and the design work has been carried out by the Bureau of Reclamation. Paul Grafe is managing director for the contractor, Charles P. Dunn is general superintendent and A. J. Ackerman is chief engineer. The government is represented on the work by E. S. Randolph, construction engineer.

## Second Lot of Bids Rejected for San Gabriel Dam

All the bids received at the second call for bids on the San Gabriel Dam of the Los Angeles Flood Control District have been rejected. The dam is to be a large rock-fill structure costing about $10,000,000.

Bids on the whole work, according to E. C. Eaton, chief engineer of the district were about 15 per cent above his estimates. Of the 19 bids received for work under separate contracts 10 were below the engineer's estimates. The lowest bidder on the excavation, George G. Pollock, asked permission to withdraw his bid.

All bids were rejected by the board of supervisors and Mr. Eaton was instructed to readvertise the whole work, also to provide for alternate bids by dividing the work into six contracts, to designate location of quarries with separate bids for each quarry.

Specifications are expected to be ready by Oct. 31 and bids will be opened about Nov. 15.

Proposals were asked for on the following:

1. Construction of entire dam with gunite facing.
2. Construction of entire dam with a facing of poured concrete.
3. All open-cut excavation.
4. Tunnel driving.
5. Quarrying and placing rock fill.
6. Concrete facing of gunite.
6a. Concrete facing of poured concrete.
7. Drilling and grouting.
8. Placing steel and metal work.

Single bids of $11,268,978 and $11,236,473 on items 1 and 2 were received from Constructors, Inc., the combination that submitted the only bid received on the first call (*ENR*, Aug. 11, p. 177).

On Item 3 the following bids were received: Haddock, Donovan & Son, $920,020; Mittry Bros., $893,000; Holland & Palmer, $884,250; and Geo. G. Pollock $684,730. On Item 4 Robinson-Roberts and Herman Baruch Corp. bid $336,537; S. H. Palmer and J. P. Holland, Inc. $279,490; Floyd Strafner $460,970; Lindgren & Swinnerton, $398,270; and Mundro Engineering Co. $471,610.

On item 5 a single bid of $9,068,050 from Constructors, Inc., was received.

On Item 6 and 6a American Concrete and Steel Pipe Co. bid $[illegible] and $969,177 respectively. On Item [illegible] Dam G. Longden bid $132,895; Empire Concrete Cutting Corp. $132,595; and Halliburton Grouting Co., $103,74[illegible]. Four bids were received on Item 8, C. M. Hill $120,909; Soule Steel Corp., $154,[illegible]; Los Angeles Contracting Co., $137,[illegible] and American Concrete and Steel Pipe Co. $139,319.

## Pasadena To Force Decision on Use of Pine Canyon Reservoir

In order to obtain a definite decision as to whether or not the Metropolitan Water District of Southern California will use the reservoir to be formed by Pine Canyon dam, now under construction by the city of Pasadena, Calif., as a distributing reservoir for the proposed Colorado River aqueduct system, the city is to vote on the question of withdrawal of the water district at a special election to be held Oct. 1.

Call for the special election was precipitated by the fact that present Pasadena taxpayers are faced with the prospect of paying for the $10,000,000 Pine Canyon project in addition to paying their proportionate share of the cost of the Colorado River aqueduct supply. The Pine Canyon reservoir will furnish sufficient water for 200,000, or twice the present population of Pasadena. When its construction was approved about two years ago, voters in Pasadena were given to understand that part or all of the cost of the reservoir would be paid by the water district in order to include the reservoir in its distributing system. There is, however, a possibility now that the reservoir might not be used.

After Oct. 2 Pasadena cannot legally withdraw from the district without obligating itself to its $2,000,000 share of the first aqueduct bonds of $40,000,000.

## California Board Broadens Structural Engineer Title

A change has been made in the rule governing the granting of the special title "structural engineer," by the California Board of Registration for Civil Engineers, to include the acceptance of experience in general structural work. The original rule of the board provided that only those with structural experience in connection with buildings were eligible. Legal opinion held that such a rule was not in accord with the law and the rule was revised accordingly.

Requirements of applicants for the special title include 3 to 5 years of responsible charge in structural lines (any branch) for eligibility for examination. With more than five years experience an applicant may be granted the title without examination. At present about 250 applicants have been granted the title structural engineer, including many in bridge and heavy construction work.

H. M. Jones has been appointed permanent secretary of the board. He was formerly in private practice in Los Angeles and secretary of the local section of the Am.Soc.C.E.

## Institute of Steel Construction To Meet in Pittsburgh

The tenth annual convention of the American Institute of Steel Construction is to be held in Pittsburgh Oct. 20-21.

Decision to hold the meeting in Pittsburgh and to confine it to a two-day business session was reached last week following an inquiry among members of the institute. Pittsburgh was selected for the business meeting because of its central location in relation to the steel industry.

As noted last week, the Institute also expects to join the Highway and Building Congress to be held in Detroit in January.

## Texas To Assume Interest on Bonds of Road District

Repayment by the state of expenditures on state highways by counties and road districts was authorized at a recent session of the Texas state legislature. At the time the bill was passed, it was estimated that about $92,000,000 of county and district road bonds were outstanding but a subsequent check by the state comptroller indicates that the amount is more nearly $110,000,000. All bonds and warrants of counties and road districts which mature after Jan. 1, 1933, the proceeds of which, exclusive of the cost of rights-of-way, actually were expended in the construction of roads that constitute a part of the state highway system or of roads relocated for such systems, will be paid out of a fund realized by the state from setting aside one cent of the present gasoline tax of four cents.

## St. Lawrence Waterway Both Opposed and Endorsed

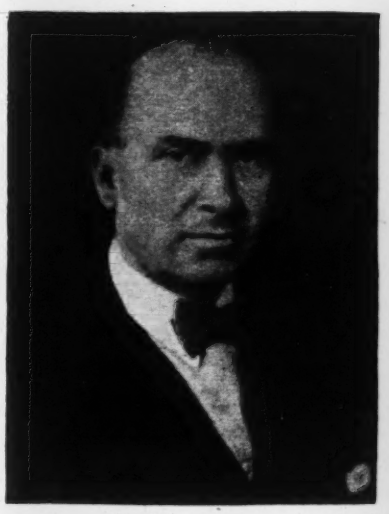
Both approval and opposition to the proposed St. Lawrence ship canal were expressed at a meeting held last week, opposition coming from the meeting of the New York State Waterways Association in Buffalo, and approval from the meeting of the Great Lakes Harbor Association held in Toronto. In Buffalo the waterways association went on record as declaring that the proposed St. Lawrence development "is economically impractical and unnecessary and its construction would be an unwarranted waste of public funds." The association states further that "if an emergency or future development makes necessary the construction by the federal government of a ship canal from the Great Lakes to the ocean, the route of the present barge canal from Waterford to the Great Lakes should be utilized for that purpose." By resolution the association urged upon Congress the deepening of the barge canal to 14 ft. but it opposed transfer of title to the canal to the federal government.

At the Toronto meeting the proposed waterway was declared to be necessary to the farmers of both Canada and the United States in order to make it possible for them to compete with other countries in the world's grain market. Resolutions were passed calling for the establishment of regional and state conferences to promote ratification of the St. Lawrence waterway treaty.

## John R. Slattery, Head of New York Subway, Dies

John R. Slattery, general manager of the operating organization for the new municipal subway system in New York and deputy chief engineer of the Board of Transportation, died suddenly at his home in New York on Sept. 23. Death was due to a heart attack attributed to overwork. At the opening of the new subway on Sept. 10, which marked the climax of his strenuous campaign of organizing the subway for operation, Col. Slattery collapsed from a similar attack, and though later he appeared to be recovering, the fatal attack followed twelve days later.

Early in the summer, when the city ordered the Board of Transportation to



John R. Slattery

take over the operation of the subway it had been building during the past seven years, the board chose Col. Slattery, its deputy chief engineer, for the highly responsible task of building up an operating organization. His conscientious and unremitting application to this difficult assignment in addition to his duties in the engineering department proved to be too great a burden even for his vigorous frame.

John R. Slattery was born in Athens, Ohio, Jan. 31, 1877, and graduated from the U. S. Military Academy at West Point in 1900. Assigned to the Engineer Corps he was sent first to the Philippines on road and bridge work. Returning to this country in 1902 he began the typical varied career of a young army engineer officer as an assistant to Col. Amos Stickney at New York. His military career is summarized below by Gen. Geo. B. Pillsbury, Assistant Chief of Engineers; it ended in 1925, when, as district engineer at New York, he resigned his commission to accept appointment as deputy chief engineer of the Board of Transportation, under Robert Ridgway, chief engineer, to take charge of the field operations in building the new Eighth Ave. subway, then just beginning.

Of Col. Slattery's connection with the subway work, Mr. Ridgway said:

"During the seven years we have been closely associated I learned to lean on him very much and to have the highest respect and esteem for him. He was a loyal and efficient collaborator, very thorough in his work and prompt in reaching the many decisions necessary to progress.

"It is difficult to think of carrying on without him. Probably the most outstanding feature of his work here was the operating organization he built up. It was a gigantic task to do this—starting from nothing—and its successful accomplishment is in itself a monument to his memory. He gave without stint of his time and energy to the public service and his devotion to it always will be remembered.

"The city has lost a servant whose place it will be extremely difficult to fill."

The unusual respect in which Col. Slattery was held by the contractors who worked under him is clearly set forth by Frederick L. Cranford in the following statement made to this journal:

"Charles H. Locher and I had contracts for the construction of two important sections of the Eighth Ave. subway in the heart of Manhattan, so that I had the pleasure and the honor of working under Col. Slattery and to be intimately associated with him. His thorough knowledge of and experience in his profession, his background and instincts of a gentleman, gave him the courage and confidence to meet any questions with an open mind and to consider and determine them strictly on their merits, and thus developed the unusual combination of an engineer and an executive, competent to handle with distinction his great work and to endear him to those who worked with and under him."

The magnitude of Col. Slattery's work on the Eighth Ave. subway, the world's largest construction operation measured in cost, somewhat obscures his earlier military career at the moment. That, however, was notable. Of it Gen. Pillsbury says:

"Colonel Slattery had a distinguished service of 26 years in the Corps of Engineers of the army. He was successively district engineer at Honolulu in charge of harbor improvements in the Hawaiian Islands; at Jacksonville, in charge of river and harbor and fortification works in Florida; at Vicksburg, in charge of flood control works in the 3d Mississippi River district, and improvements of the tributary streams in that district; at Portland, Ore., in charge of the improvement of the Columbia River and other rivers and harbors in Oregon; at Nashville, in charge of the improvement of the Cumberland and lower Tennessee Rivers, and at New York in charge of the improvement of the great harbor of New York and of other works in the First New York Engineer District. He resigned from the service from the last position to take up his important duties with the Board of Transportation of New York City. As a young lieutenant he had service in the Philippine Insurrection, as a captain in the second occupation of Cuba, and as colonel in the World War, where he commanded the 312th Regiment of Engineers, and was chief engineer of the 7th Army Corps.

"In his long service with the Corps of Engineers he was universally known as an executive of sound judgment and of devoted attention to duty, and as an accomplished engineer. He was held in the highest respect and esteem by the entire engineer department. His successful accomplishment of the important work with the City of New York was highly gratifying to his brother officers, and his untimely death is a deep personal loss to his associates in the Corps of Engineers."

# N.Y. Board Approves Four Housing Plans to Cost $60,000,000

FOUR proposals for large-scale housing developments in New York City have recently received the tentative approval of the New York state housing board, according to an announcement made by the board on Sept. 22. It is understood that R.F.C. financing is contemplated, and that when the backers obtain government approval a final state permit will be granted. The largest of the projects, sponsored by Brown, Wheelock, Harris & Co., is in the Lower East Side section of Manhattan, where the need for slum eradication has long been discussed. It will cost $45,000,000, cover twenty blocks and provide housing for 100,000 persons. In Woodside, Queens, the Dick-Meyer Corp. proposes to build an apartment unit containing 5,976 rooms and costing $7,000,000. Theodore Englehardt is the architect. The project in the Bronx at E. 213th St. and Boston Post Road is sponsored by Nathan Straus, Jr., and Starrett Brothers & Eken. It will cover seven city blocks and include 100 four-story walk-up units, providing 5,000 rooms at about $11 per month per room. The buildings will cover 34 per cent of the plot. Clarence Stein is the architect. In Brooklyn the Cypress Housing Corp., backed by Henry L. Osias, Benjamin Strizber and Alfred Kaskel, will erect a $1,000,000 six-story elevator building containing 728 rooms, also to rent at $11. Tabatchnik & Brook are the architects.

Plans for the Lower East Side development are said not to be entirely complete, but it is understood that 36 twelve-story buildings covering 42 per cent of the plot are proposed, and that the ground area will be divided into so-called super-blocks, each containing four city blocks, with the streets closed off for park purposes.

In addition to the four projects which have been approved, separate announcement has been made of a fifth by Sloan & Robertson, architects for August Heckscher. This latter project is planned for the seven-block, city-owned Chrystie-Forsyth St. area in lower Manhattan. Because the land is owned by the city, approval of the city planning commission and the board of sinking fund commissioners must be secured before the plans are submitted to the state housing board, it is understood. The estimated cost is between fifteen and seventeen million dollars. Of the 305,000 sq.ft. in the plot, 47 per cent will be occupied by nineteen-story apartment buildings providing a total of 8,913 rooms to rent for about $12.50 per room per month.

The old tenements on the Chrystie-Forsyth area were demolished several years ago. Since that time numerous plans have been made for housing developments on this land, among them those by Otto Shulhoff and by Howe & Lescaze, New York architects. Howe & Lescaze propose 24 nine-story elevator apartments to cost $6,000,000 and rent for about $11 per room. The buildings would occupy less than 15 per cent of the available land.

In all of the large-scale housing plans proposed, ample playgrounds and parks, some of them one story above the street, are a prominent feature.

## Water Shortage Threatened in Northeastern Pennsylvania

Warnings of a possible shortage of water, especially in the northeastern part of the state, have been sent out by the Secretary of Health of Pennsylvania. Except in the Philadelphia area a water shortage is anticipated and waterworks officials have been urged to conserve their supplies. In the northeastern part of the state streams are at the lowest point reached in eight years.

## *Personal Notes*

W. H. PLACHY, civil engineer, pioneer in the location of the Seattle water supply system, has been retired after 44 years of service to the city of Seattle, chiefly in its engineering department.

JOHN D. FITCH, formerly assistant engineer with the Charles B. Hawley Engineering Corp., Washington, D. C., is now engineer associate, American Engineering Council, Washington, D. C.

ALBERT B. JONES, captain, Corps of Engineers, who has been serving with the Board of Engineers for Rivers and Harbors in Washington, has been assigned to duty with the 6th Engineers at Ft. Lewis, Washington.

WILLIAM E. MOTT, director, college of engineering, Carnegie Institute of Technology, Pittsburgh, Pa., has been granted a leave of absence for the first semester, 1932-33, and upon expiration of his leave will retire from active teaching. Mr. Mott has been connected with the institute for the past 23 years, first as professor of civil engineering, then as dean and later as director of the college of engineering. He is a graduate of Massachusetts Institute of Technology in the class of 1889.

## *Obituary*

WILLIAM F. CROCKETT, long in building work in New York City, died suddenly on Sept. 24 at his summer home at Saybrook, Conn. During the World War Mr. Crockett served as a major in the Transportation Corps in France.

FRANCIS W. BELKNAP, president, Phoenix Construction Co., New York, died suddenly in the Pennsylvania Station at New York while on his way to business on Sept. 22. Mr. Belknap was a graduate of Massachusetts Institute of Technology in the class of 1895. With William Shannon he formed the Phoenix Construction Co. and since Mr. Shannon's death a few years ago has served as president of the organization.

FREDERICK W. KELLEY, president of the North American Cement Co. since its organization in 1925, died at his summer home at Altamont, N. Y., Sept. 19. Mr. Kelley was 62 years old. Four years ago he suffered a stroke and had been unable to walk thereafter, but had continued his active interest in the business and in the cement industry generally. At one time Mr. Kelley served as president of the Portland Cement Association. He was a mechanical engineer, a graduate of Cornell University in the class of 1893.

GEORGE MILTON JARVIS, civil engineer, retired, died at his home in Baltimore, Md., Sept. 17, after a long illness. Mr. Jarvis was 83 years old. After graduation from Cornell University he went to Brazil on railway work. Returning to the country two years later, he was with the New York Central for a short time and then went to Texas with the Missouri, Kansas & Texas Railroad and the International & Great Northern.

CHARLES F. GOOB, former chief engineer of the city of Baltimore and more recently in private engineering practice there, died Sept. 27 at Baltimore following a heart attack on Sept. 22. He was 48 years old. At the time of his resignation from the city service in June of last year Mr. Goob had been in the city service continuously since 1919. Previous to that time he had taught at Baltimore Polytechnic Institute, from which school he graduated, had been in public utility work and in the Navy. His first service in the city was as head of the electrical department. Subsequently he was made highway engineer of the city and in 1927 chief engineer.

## SOCIETY CALENDAR

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual meeting, Washington, D. C., Nov. 14-18.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, annual meeting, Pittsburgh, Pa., Oct. 20-21.

AMERICAN PUBLIC HEALTH ASSOCIATION, annual meeting, Washington, D. C., Oct. 24-27.

AMERICAN SOCIETY OF CIVIL ENGINEERS, fall meeting, Atlantic City, N. J., Oct. 5-8.

AMERICAN SOCIETY OF MUNICIPAL ENGINEERS, annual meeting, Detroit, Mich., Jan. 16-20.

AMERICAN WELDING SOCIETY, fall meeting, Oct. 3-7, Buffalo, N. Y.

ASPHALT INSTITUTE, Asphalt Paving Conference, New Orleans, La., Dec. 5-9.

HIGHWAY AND BUILDING CONGRESS participated in by fourteen national engineering societies and trade associations, Detroit, Mich., Jan. 16-20.

INTERNATIONAL CITY MANAGERS ASSOCIATION and GOVERNMENTAL RESEARCH ASSOCIATION will hold a joint annual conference at Cincinnati, Ohio, on October 24 to 26.

NATIONAL ASSOCIATION OF RAILROAD AND UTILITIES COMMISSIONERS, annual meeting, Hot Springs, Ark., Nov. 15-18.

NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS, annual meeting, New York City, Sept. 29-Oct. 1.

NATIONAL SAFETY COUNCIL, annual congress, Washington, D. C., Oct. 3-7.

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ROCKY MOUNTAIN SECTION, American Water Works Association, will hold its annual meeting and exhibit at Denver, Colo., Oct. 24-26.

WISCONSIN SECTION, American Water Works Association, will hold its meeting at Appleton, Wis., Oct. 11-12.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its annual meeting in Chicago June 26-30 during the Century of Progress exposition.

SOUTHERN AND CENTRAL ILLINOIS WATER TREATMENT PLAN OPERATORS met Sept. 23 at Vandalia and discussed tastes, tests and troubles with river waters, taste and odor control and distribution system problems.

MICHIGAN CONFERENCE ON WATER PURIFICATION meets Oct. 5-7 at Mt. Clemens. Subjects scheduled include the following: sterilizing new mains and reservoirs; carbon, ammonia and ferric uses and users; hydraulics of filters; wash water costs; coagulation and color removal.

## New Building Code May Delay Housing Projects at New York

The fact that the new building code for the city of New York has not yet been approved by the Board of Estimate may delay the start of work on large-scale housing projects under the Emergency Relief and Construction Act has been brought to the attention of the building interests of New York City by the Dow Service Daily Building Reports. Even though the federal money should be made available, the Dow reports state, there is scarcely an investor who would sanction proceeding with this type of construction under a code that is certain to be superseded in a very short time by one which will make obsolete any new building construction under old and outworn construction standards and practices. The report points out, however, that there is good reason to believe that most of the controversial points concerning the new building code prepared by the Merchants' Association have been cleared up and that no delay may be expected.

## Strike on $8,000,000 Post Office at Pittsburgh Settled

The strike on Pittsburgh's $8,000,000 post office, of some two months' duration, throwing out of employment about 200 workmen, was settled on Sept. 21 by the contractors accepting the union's interpretation of their agreement. Union hoist operators will unload sand and gravel from barges to trucks for delivery to the Post Office Building. Union hoist operators had been used at the building site heretofore, but were not originally engaged to unload these materials from the barges.

The general contractor, Aronberg Fried Co. of New York City, is a member of the Building Trades Employers Association, who have an agreement with Local Union No. 905 of the International Union of Operating Engineers "to use union hoisting engineers on sand and gravel hoists on building and construction work . . . when under control of a member of the Building Trades Employers Association." There are no sand and gravel hoists used in the building of the post office. The sand and gravel contractor, the Pittsburgh Gravel Co., a non-union concern, not a member of the B.T.E.A., used non-union hoist operators in unloading sand and gravel from the barges on to the trucks, to which the union objected.

To help get matters adjusted, the contractor, during the latter part of August, made arrangements with the Pittsburgh Gravel Co. to purchase the sand and gravel on the barges, f.o.b. wharf, and to unload same with union men at some extra cost. The union agent required a written interpretation of the clause in question and after receiving it and accepting it he subsequently demanded more concessions before ordering the men back to work.

Due to the delay the building will not be closed in before cold weather sets in.

## Contracts and Capital

**CONSTRUCTION**

(Thousands of Dollars)

| | Weekly Average Sept. 1931 | Sept. 1932 | Week Sept. 29 1932 |
|---|---|---|---|
| Federal government | $10,409 | $4,603 | $3,161 |
| State and municipal | 21,880 | 15,673 | 17,795 |
| Total public | $32,289 | $20,276 | $20,956 |
| Total private | 11,950 | 2,763 | 2,890 |
| Week's total | $44,239 | $23,059 | $23,846 |
| Cumulative, Jan. 1 to date: | | | |
| 1931 construction | | | $1,965,114 |
| 1932 | | | 915,401 |

Decrease, 53 per cent.

**NEW PRODUCTIVE CAPITAL**

(Thousands of Dollars)

| | Weekly Average Sept. 1931 | Sept. 1932 | Week Sept. 24 1932 |
|---|---|---|---|
| Total private and public | $45,500 | $16,900 | 15,500 |
| Cumulative, Jan. 1 to date: | | | |
| 1931 new capital | | | $1,897,000 |
| 1932 new capital | | | 661,500 |

Decrease 65 per cent.

## *ENR* Cost and Volume Index

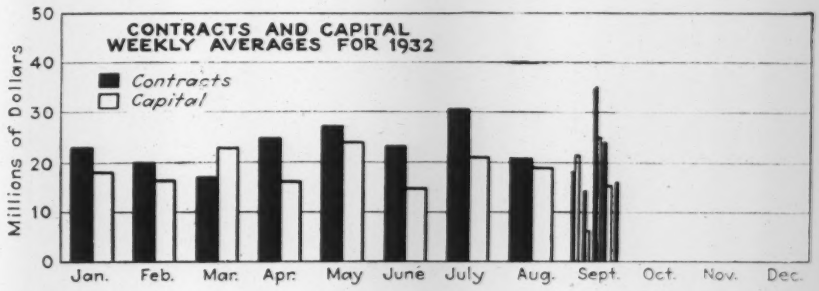
| Cost | | Volume | |
|---|---|---|---|
| **September, 1932** | 157.96 | **August, 1932** | 111 |
| August, 1932 | 156.80 | July, 1932 | 166 |
| September, 1931 | 171.40 | August, 1932 | 187 |
| 1931 (Average) | 181.35 | 1931 (Average) | 220 |
| 1930 (Average) | 202.85 | 1930 (Average) | 260 |
| 1913 Average | 100.00 | | |

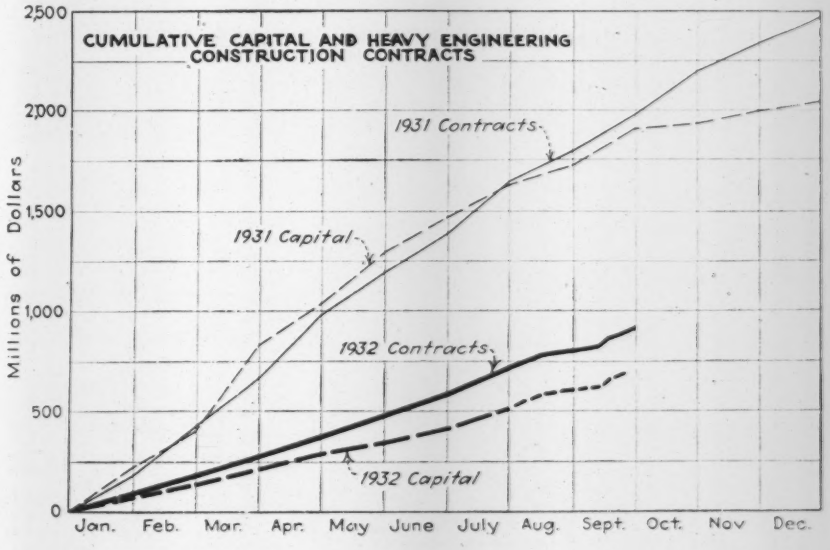
# Engineering Contracts and Capital

THE THIRD consecutive week of heavy highway lettings, amounting to 15 millions, brought the week's total of engineering construction contracts to $23,846,000. Large highway awards were reported from the South and from the Mid-West. Tennessee led all the states for the past week with road lettings aggregating $2,644,000. Other large highway awards reported are: Kentucky, $1,026,000; Texas, $2,303,000; Alabama, $1,119,000; North Dakota, $721,000 and Nebraska, $736,000. Federal contracts awarded during the week amounted to $3,161,000. Private work was light as usual, totaling $2,890,000. September closed with an average weekly of contract awards amounting to $23,100,000, as compared with August, 20.4 millions; July, 30.1 millions and June, 23.7 millions.

New productive capital issues reported for the week total 15.5 millions, all of which were public except 2 millions. The largest single issue of the week was floated by St. Louis for public buildings and other improvements, amounting to $8,200,000.

Proposed projects for probable early bidding, revealed during the week include the following post offices and federal buildings: Los Angeles, $5,850,000; San Antonio, $1,400,000; El Paso, $1,250,000; Dallas, $850,000; Buffalo, $2,000,000; Boston, post-office workshop, $3,000,000 and Indianapolis, post office addition, $1,200,000. Other large projects proposed include: Montour Railroad extension, 13 miles, Negley, O., to Smiths Ferry, Pa., $1,000,000; school, Brooklyn, $1,150,000; wharf improvements, Pittsburgh, $1,000,000; waterworks, Brandywine, Del., $681,000; private bridge, Yorktown to Gloucester Point, Va., $1,650,000. Bids have been called for Oct. 17 for dredging at Port Richmond, Philadelphia, $825,000.



# *Construction Equipment and Materials*

## Shovel Built for Ease in Control

The main drums of the Model 17 standard shovel now being manufactured by the Keystone Driller Co., Beaver Falls, Pa.,

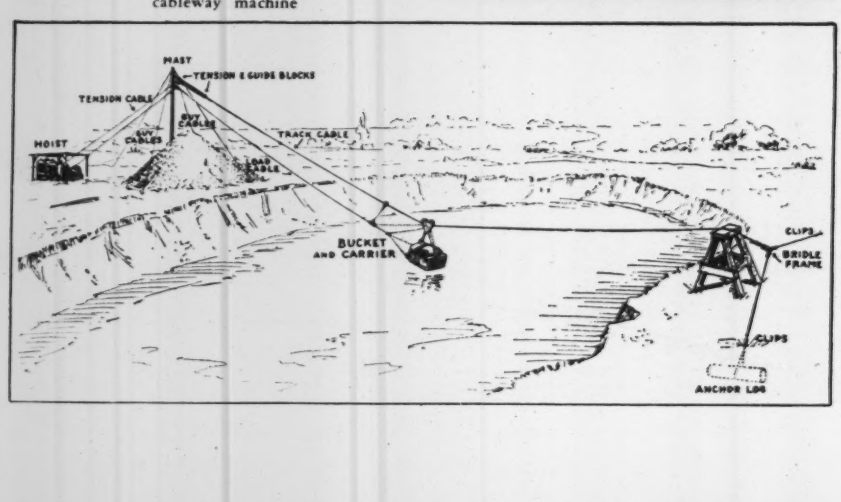
New shovel by Keystone Driller Co.

are equipped with clutch wheels of the V-grooved type of large diameter. The drums are actuated through planetary gearing. High clutching and friction speeds are characteristic of the design of the machine. Ball bearings are used under the main drum and transmission shafts and rollers in the planetary gearing. The machine is designed to work with constantly slipping frictions. The result is a close approximation of the control obtainable by means of a steam throttle. The plunger-type 1 yd. skimmer bucket, designed for both shallow cutting and high bank excavation, is operated by one line, and is capable of a digging speed of 120 ft. per minute. A planetary-type sluing mechanism similar in design to the main drum, except that the V-type friction wheel is here replaced by a wide, flat-brake wheel and external contracting band. The weight of the machine is 30 tons with skimmer or pullscoop, and 37 tons with standard shovel boom. It is powered with an 82 hp. Climax Bluestreak engine.

## Slackline Cableway Machine

Sauerman Bros., Inc., 438 S. Clinton St., Chicago, Ill., announces a new series of drag scraper and slackline cableway machines, designated as the Sauerman "Utility" machines. The Utility slackline cableway excavators are offered with four different sizes of buckets, 9, 13, 20 and 26-cu.ft. capacity, and with operating spans of 300, 400 and 500 ft. The machines are gasoline driven, electric driven or belt driven. The Utility bucket is provided with a structural steel bail, welded back, and a renewable, reinforced bottom. The drag scraper machines come in five models of gasoline-driven machines and a like number of electric-driven and belt-driven machines. The buckets used are Sauerman "Crescent" scrapers of 9, 13, 20, 26 and 40 cu.ft. capacities.

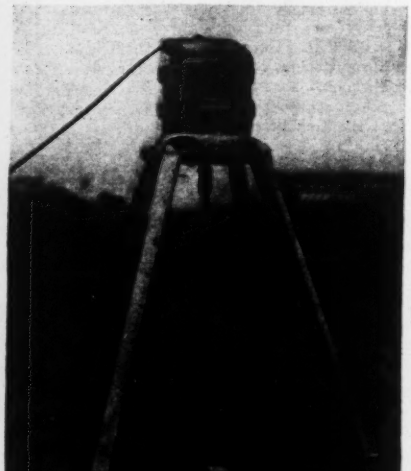
Sauerman Bros.' new drag scraper and Slackline cableway machine




## Propeller-Type Aerator and Mixer for Water Purification Plants

Violent mechanical agitation and mixing, with an appreciable time of contact of water and air or other fluids, is obtained in a new type of aerator and mixer brought out recently by the Rotex [illegible] Company, Memphis, Tenn. The aerator was developed by W. N. Jones, civil engineer, while working on waterworks filtration problems at Tampa, [illegible], and Memphis, Tenn., to reduce the carbon dioxide and remove taste and odors from the water.

New agitator uses boat propeller.



The aerator consists of one or more motor-driven boat propellers, 8 in. in diameter, mounted on a 4-leg structural steel frame made up of tee irons and angles. Motors of ½ hp. and ¾ hp. are used, operating at 850 to 900 r.p.m. The outfit is self-contained and may be placed in a waterway, shallow basin or chamber to which the air has access. The propellers which are submerged but a few inches, throw the water against baffle plates and this impact, together with the upward thrust, forces the water upward in the form of an inverted flat cone, at the same time breaking the liquid into a fine spray.

## *New Equipment in Brief*

*Air Hoist.* Ingersoll-Rand Co., New York, N. Y., has developed four sizes of double-drum "Utility" air hoists that are said to offer distinctive features. The application of these hoists is in slushing and scraper loading in mines and quarries, sand and gravel pits, etc., wherever portable double-drum air hoists are required. A feature of the hoist is the single-lever control of the clutches and throttle valve.

*Welding Rod.* A new Allegheny metal welding electrode has just been announced by Joseph T. Ryerson & Son, Inc., Chicago, Ill. The rod is applicable to Allegheny metal and other stainless steels in the 18-8 chrome-nickel group. The rod is coated with a special flux that produces a non-active gas surrounding the hot metal and prevents the oxygen of the air from attacking the metal and forming oxides. The heavy slag formed on top of the weld acts as a protective agent as the metal cools.

## *Business Notes*

MANNING, MAXWELL & MOORE, INC., announces its acquisition of the business of the Box Crane & Hoist Corp., of Philadelphia, Pa. The plan is to merge the business thus acquired with that of the Shaw Electric Crane Co., a Manning, Maxwell & Moore subsidiary, in the Shaw plant at Muskegon, Mich. The merged business will operate as the Shaw-Box Crane & Hoist Co.

MURRAY IRON WORKS CO., Burlington, Iowa, announces that S. A. Hadley, 609 Interstate Building, Kansas City, Mo., has been appointed sales representative in the Kansas City territory for boilers, engines, turbines, reduction gears and unit heaters.

R. STEEL & SONS, INC., Long Island City, N. Y., manufacturers and rebuilders of standard and special machinery, announce the appointment of Fred Romney, formerly with the Bucyrus Erie Shovel Co., as their field representative.

THE LINCOLN ELECTRIC CO., Cleveland, Ohio, announces the appointment of C. E. Tenney as sales manager of the Chicago district.

KOPPERS CONSTRUCTION CO., Pittsburgh, Pa., a subsidiary of the Koppers Co., has acquired control of the Hiler Engineering & Construction Co. of Brooklyn, builders of incinerators. The operations of the Hiler Company are to be continued under its own name.